Bidding for Firms: Subsidy Competition in the U.S.

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Abstract

In the United States, state and local governments compete to attract firms by offering discretionary subsidies. I use a private value English auction to model the subsidy bidding process and quantify the welfare effects of competition. The allocation of rents between states and firms depends on the heterogeneity in states' valuations for firms and the substitutability of locations. I find that competition increases welfare by about 10% over a subsidy ban, but states compete away the surplus, transferring the majority of rents to firms. Moreover, political concerns affect states' valuations for firms. These findings dampen any interpretation of subsidy competition as an effective place-based policy.

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1 Introduction

In 1976, after dozens of governors traveled to Germany to make their pitch to Volkswagen executives and multiple rounds of bidding, Volkswagen decided to locate their first U.S. plant in Pennsylvania. The German automobile manufacturer promised to create 5,000 jobs and received a discretionary subsidy worth \$100 million. Forty years later, discretionary incentives are a mainstay of local economic development policy in the United States. In 2017 alone, states promised over \$6 billion in tax incentives and subsidies—one third of their economic development budget—to just 20 firms.

Some policymakers have proposed a ban on subsidy competition, arguing that it is a zero-sum game that only serves to transfer rents from local governments to firms (Farmer, 2019; Burstein and Rolnick, 1995). However, discretionary subsidies can increase welfare if they compensate firms for locating where they will create more value, improving the match between firms and locations. If subsidy competition improves matches, allowing states and local governments to offer specialized tax breaks and incentives can increase the allocative efficiency of firm location, and may be an effective place-based policy to address rising geographic economic inequality within the United States.

In this paper, I model the subsidy "bidding" process and quantify the welfare effects of subsidy competition. The English auction model I use allows local governments to value both both firm and location characteristics when submitting bids, and allows firms to take both subsidies and location characteristics into account when choosing their location. In order for subsidy competition to strictly improve total welfare (firm profits plus government valuations) it must be that competition induces some firms to chose locations that they wouldn't chose in the absence of a subsidy offer. If government valuations and firm profits are strongly positively correlated, then total welfare and profits are strongly positively correlated and subsidy competition, which allocates firms to the highest welfare location, will not impact the location choice. If valuations and profits are strongly negatively correlated, then subsidies will change firms' location choice, thereby increasing welfare. The size of this welfare gain is a function of the heterogeneity in locations' valuations for firms. I estimate the joint distribution of firms' preferences over location characteristics and local governments' (revealed) valuations for firms that rationalizes observed subsidies.

I have three main findings. First, firm profits and valuations for firms are negatively correlated. This means that subsidies can have a meaningful effect on firm location decisions. In the counterfactual, I find that at least 50% of firms would locate in another state if there was no incentive spending.

Taken together, subsidy competition increases total welfare by 10% by allocating firms to places with higher valuations. Second, most welfare gains do not accrue to the winning localities. States compete away the surplus created by improving match values, transferring the majority of rents to firms in the form of discretionary subsidies. In the aggregate, state and local governments would be better off in the absence of subsidy competition.[1] Third, higher valuations for firms are correlated with low personal income per capita, recent declines in manufacturing, and higher unemployment rates. This suggests that valuations reflect the location-specific economic benefit of winning a firm. However, economic benefit is not the sole determinant of willingness to pay. A firm's "value" to a location is also correlated with politicians' career concerns—states with governors facing re-election value firms substantially more than their term-limited counterparts. Therefore, the government valuation of winning a firm does not necessarily reflect the benefit the firm will create for their constituents.

Glaeser (2001) notes, "Tax incentives seem to be a permanent part of the urban economic landscape. However, economists do not yet know why these incentives occur and whether they are in fact desirable." Two major obstacles stymie progress in this area. First, there is a lack of coherent data on subsidies, due to limited transparency from state and local governments on the subsidy-setting process. Most empirical work focuses on one tax credit or incentive program, but states have many levers and programs to build a subsidy deal for an individual firm. Second, even if researchers did have data on subsidy deals, the observed subsidy is an equilibrium outcome—the result of the firm location decision, the willingness to pay of the local governments, and a competition between localities. To this end, this paper makes two contributions to the literature. First, I introduce a new, hand-collected data set on state-level incentive spending and firm-level subsidy deals across the United States. This data set is unique because it includes details on the terms of each subsidy deal, the runner-up location, and the number of competitors in the subsidy competition. Second, I develop and estimate a tractable model of the subsidy competition "market," which encompasses many real world features of subsidy competition in the United States. I leverage techniques from the empirical auction literature and the new data to estimate the model and quantify the welfare effects of subsidy competition.

In the first part of the paper I describe the institutional background of subsidy competition in the United States, introduce new data on subsidy-giving, and present reduced-form evidence. The data set has two parts: total state-level incentive spending and firm-level discretionary subsidies. I collect

[1] This result is dependent on the degree of heterogeneity in valuations. If the valuations were sufficiently heterogeneous, it would not be the case that most of the surplus (from the point of view of the locality) is competed away.

the state-level incentive spending data set by reading state budget documents and tax expenditure reports from each state. I collect data on the firm-level discretionary subsidies from the policy group *Good Jobs First*, the *Site Selection Magazine* annual "Top Deals" report, and by reading news articles and press-releases on each subsidy deal. The sample I use for analysis in this paper is a set of subsidy deals for which I know the firm, location, subsidy size, number of jobs promised, industry, and runner-up location in the competition. These subsidies generally include contributions from both the state and local governments—I use the term "state" as the government of interest in most of the paper, but one can think of the state and local government determining the subsidy offer together. The data contain 387 firm-level subsidy deals from 2002-2017, which are selected on being the result of a competition between localities and being worth over $5 million to the firm. The average firm promises to create 1,400 jobs and receives a subsidy worth $150 million over 10 years, which is about $107,000 per job promised or $10,700 per job per year.

According to policymakers, the primary purpose of giving subsidies for firm locations is job creation. However, the number of direct jobs the firm promises explains less than 10% of observed subsidies. This may be due to differences in location characteristics; a less attractive place needs to offer a larger subsidy than its more attractive counterparts, all else equal. In fact, local characteristics that may be favorable to a firm, e.g. right-to-work laws and research universities, are correlated with smaller discretionary subsidies. There may also be differences in the location-specific valuation of new jobs. In the aggregate data, states that experience decreases in the employment population ratio are more likely to increase per capita incentive spending. I use a model to disentangle differences in firm profits in a given location from the underlying location valuations for firms.

In the model, state governments compete for firms with subsidies, but firms choose the location that offers the highest payoff, where payoff is a function of both the subsidy offer and the location-specific profit. I model this as an open outcry ascending (English) scoring auction. This modeling approach captures many real world features of subsidy competition in the United States: subsidies are not the only factor in a firm's subsidy decision, there are multiple rounds of bidding in competition, and states know the offers of their competitors.[2]

The argument that subsidy competition can increase the allocative efficiency of firm locations relies on the assumption that a firm will create different amounts of value in different localities. By

[2]The English Auction can resemble markets with negotiated or bargained prices, and in my setting it captures the negotiation between the firm and multiple locations. Recent work uses the English Auction to model mortgage and consumer loan markets (Allen, Clark and Houde, 2019; Cuesta and Sepúlveda, 2019).

modeling subsidy competition as a private value auction I assume that each state can accurately anticipate the value a firm will create in its jurisdiction. There is no winner's curse—subsidy competition must be efficient. Although I estimate a model that presumes efficiency gains, my results on the distribution of rents and the determinants of states' willingness to pay do not follow directly from this modeling choice. In fact, this presumption is conservative with respect to my results, as it is optimistic about the gains from competition, which I find to be negligible.

In most empirical auction applications, the observation of the winning bid and the number of bidders is sufficient to recover the underlying distributions of valuations for the object. However, in my setting subsidies and location characteristics are substitutes—the winning location need not be the place that offers the largest subsidy.[3] In order to achieve identification of state governments' valuations for firms, I also need to know the scoring rule, e.g., the firms' preferences over location characteristics. I identify the scoring rule using the model: the observed winning bid is the subsidy that sets the payoff in the winning and runner-up location equal. In other words, the winning subsidy is equal to the difference in the firm profits in the runner-up and winning location plus the runner-up bid. Therefore, the variation in the winning subsidies and the differences in winning and runner-up location characteristics allow me to identify firms' preferences over location characteristics.

To see the intuition for this approach, imagine two subsidy deals for automobile manufacturing facilities of identical size. One plant locates in Alabama with a subsidy of \$100 million and the other locates in Ohio with a subsidy of \$140 million. In both cases, the runner-up in the subsidy competition is South Carolina, so the runner-up valuation and profit are held constant. Now suppose Alabama and Ohio have almost all of the same location characteristics: the same tax rate, the same wages, the same skilled workforce. The only difference between the two states is that Alabama is a right to work state and Ohio is not. Then, the \$40 million difference in the two observed subsidy deals can be attributed to how much automobile manufacturers prefer to locate in a right to work state.[4]

[3] It is evident that the subsidy size is not the only factor in firms' location decisions. In the case of Amazon HQ2, Atlanta, GA, Chicago, IL, Newark, NJ, Columbus, OH, Philadelphia, PA, and Montgomery County, MD each offered more than the two winning cities' bids, combined (Mak, 2018).

[4] In this step I also estimate the correlation between runner-up location characteristics and the runner-up valuation. Imagine, in this case, two subsidy deals for identical manufacturers won by the same state, Indiana. For one deal, Indiana pays a subsidy of \$300M and the runner-up is Georgia. For the other, Indiana pays a subsidy of \$270M and the runner-up is Tennessee. If Georgia and Tennesse have identical location characteristics, except for the fact that the unemployment rate in Georgia is 7% and the unemployment rate in Tennessee is 5.5%, the difference between the two observed subsidy deals can be attributed to a higher valuation for firms in higher unemployment locations, on average.

Once I have an estimate of firms' preferences over location characteristics and runner-up valuations, I predict each firm's payoff in its runner-up location. The runner-up location gives the firm the second highest payoff, which is equivalent to the second highest level of welfare (where welfare is defined as firm profit plus state valuation). This means that I can use the order statistic identity to recover the full distribution of welfare across locations (Athey and Haile, 2002). I then exploit the relationship between valuation, profits, and welfare, and invert the distribution of welfare to recover the distribution of location valuations.

I use the estimated distributions of state valuations and firm profits to evaluate a counterfactual policy in which state and local governments do not offer any discretionary tax breaks or economic development tax credits.[5] In the counterfactual up to 50% of the firms stay in the winning location, and 30% choose the runner-up locations. I simulate valuations in the winning and new locations and find that total welfare decreases by about 10% when I implement a subsidy ban, because higher valuation places are not able to express those values through bidding. This is, in part, a mechanical result—the independent private values auction says that competition must be weakly efficient.[6]

My results on the allocation of welfare between locales and firms, which are due to the heterogeneity in the distribution of valuations and firm profits across locations, are not mechanical. I find that all of the aggregate gain from subsidy competition due to increased match values is transferred to the firms; the total subsidy spending over the sample amounts to almost $60 billion, while state valuations increase by only $20 billion under competition. The payoff accrued to winning localities under subsidy competition is less than half of the payoff accrued to localities under the subsidy ban.

Although, in the aggregate, states are better off under the ban, my results suggest that any type of subsidy "truce" would likely be hard to sustain—there are clear winners and losers across geographies. These distributional implications across space are due to firms' preferences over location characteristics. Many of the states in the Midwest and South lose almost all of the firms that they had attracted with subsidies, while states like New York, California, Texas and Virginia retain all their firms or are net gainers of firms under a subsidy ban.[7]

[5]This is a partial equilibrium analysis. I do not allow states to change the corporate tax rate or invest in changing other location characteristics.

[6]I estimate a negative correlation between profits and valuations, which suggests that competition will induce some firms to choose higher valuation locations. However, when I simulate the counterfactual under the assumption that profits and valuations are distributed independently I still estimate a welfare gain, of about 6% instead of 11%. It is not only the relationship between profits and valuations that matters for welfare; the degree of heterogeneity in the distribution of valuations plays an important role.

[7]Perhaps unsurprisingly, the states with more attractive fundamentals are more likely to advocate for multi-state truces

Two additional considerations temper the estimated welfare gain from subsidy competition. First, states with governors facing re-election are willing to pay substantially more for a manufacturing firm, all else equal. In fact, the valuation for governors facing re-election is 20% higher than their term limited counterparts. This raises the issue that the "welfare" of the state decision maker may not necessarily align with that of a social planner. Second, states may overestimate the benefit of winning any particular firm. In a back of the envelope estimate I find that if states are slightly over-optimistic about the valuation of a firm, the welfare gain from subsidy competition quickly dissipates.[8] In short, although the private value auction model I estimate is one in which efficiency gains are expected, I find that the scope for discretionary subsidies to be an effective tool to reduce geographic inequality is extremely limited.

Related Literature

This paper contributes to the analysis begun by Black and Hoyt (1989), Bartik (1991), Glaeser (2001), and Garcia-Mila and McGuire (2002), all of which present the argument that subsidy competition is not necessarily a zero-sum game, but can actually lead to efficiency gains. A set of recent papers take this hypothesis to the data.

In contemporaneous work, Kim (2018) estimates the efficiency of subsidy competition with a model of competition between states. He uses a first-price private value sealed-bid auction and a larger sample which includes smaller, non-discretionary deals. His model has the innovation that there is an unobservable component to firms' profit, creating uncertainty in location choice from the perspective of the state. Despite the difference in approach, he also finds that, in the aggregate, low profit places have higher values for firms. However, he finds that firms are much less responsive to subsidies, which is mostly driven by the difference in our samples. Ossa (2018) calibrates a quantitative economic geography model using total state manufacturing subsidies. He finds that states have strong incentives to subsidize firm relocations in order to gain at the expense of neighbor states, a gain which is mostly driven by agglomeration externalities. Mast (2020) estimates a model in which New York counties compete for mobile establishments. He finds that eliminating tax breaks has a

in the post-Amazon HQ2 landscape. Lawmakers in New York State have introduced the "End Corporate Welfare Act" bill, and are encouraging other states to do the same (Farmer, 2019).

[8] If states are 10% over-optimistic about the value a firm will create, almost 20% of winning states would be subject to the winners curse, and would have offered a subsidy greater than the realized valuation.

very small effect on equilibrium firm locations, limiting the scope for gains in allocative efficiency.[9] In this paper I am able to explicitly focus on cases for which there was competition between localities for a given firm, and provide a simple framework with which to analyze subsidy competition and evaluate counterfactual policies.

This paper also relates to a more general literature on discretionary subsidy policy, which includes research on the effect of subsidy-giving on local economic growth (Greenstone, Hornbeck and Moretti, 2010; Patrick, 2016; Slattery and Zidar, 2020).[10] This literature takes an ex-post approach—what happens in a location after it wins a subsidy competition? Alternatively, I evaluate subsidy competition at the time of the subsidy deal—why do local governments offer subsidies and do subsidies improve the allocative efficiency of firm locations?

There is a substantial literature on the effect of taxes and incentives on business location and activity. Using data on firms and establishments in the United States, most researchers find very little evidence that corporate tax cuts boost entry (Carlton, 1983; Bartik, 1985; Papke, 1991; Ljungqvist and Smolyansky, 2016). With all the tax credits and subsidies available to large firms, one reason that researchers haven't found strong evidence of a response could be that the corporate tax rate does not reflect the price that larger firms are facing.[11] Suárez Serrato and Zidar (2016) and Fajgelbaum, Morales, Suárez Serrato and Zidar (2018) use spatial equilibrium models to estimate the welfare effects of changes in state taxes on firms and workers. These papers consider (among many other factors) the location-specific productivity of firms, but abstract from any location-specific benefits for the locations. My paper not only studies firm behavior, but also highlights the government objective function, and provides some insights to the government's willingness-to-pay for different types of firms, which is not the focus of most of the literature on taxes or place based policies.

The paper proceeds as follows. Section 2 contains institutional details on subsidy competition in the United State, an introduction to the data, and descriptive statistics. Section 3 presents the model and Section 4 discusses identification. The estimation procedure and results appear together in Sec-

[9] This result, he notes, may arise because he studies a sample of smaller firms that are spatially constrained.

[10] More broadly, there is a robust literature on the effect of place based policies, see, for example, Kline and Moretti (2013) and Busso, Gregory and Kline (2013).

[11] Firms also can respond to tax rates on the intensive margin, Giroud and Rauh (2019) find that multi-establishment firms respond to tax cuts by reallocating activity to the lower cost location. The location of foreign direct investment, R&D, start-up activity, and highly-productive scientists responds to tax policy across states (Hines, 1996; Wilson, 2009; Curtis and Decker, 2018; Moretti and Wilson, 2017). Taxes, grants and agglomeration have also been found to affect location choices of multinationals and manufacturing plants in Europe (Devereux and Griffith, 1998; Devereux, Griffith and Simpson, 2007; Becker, Egger and Merlo, 2012; Criscuolo, Martin, Overman and Van Reenen, 2019).

tion 5, and Section 6 provides a counterfactual policy analysis. Section 7 discusses the implications of the modeling and identification assumptions, while Section 8 concludes.

2 Background and Data

2.1 Subsidies and Site Selection

In this section I give a brief history of subsidy competition in the United States, as well as an overview of the "industry" in its current state. This includes institutional details on the composition of subsidies and the process of bidding for firms.

The practice of states offering discretionary incentives in exchange for firm locations dates back at least to the 1970s. As noted in the introduction, the earliest evidence I can find of states competing with discretionary tax incentives is in 1976, when Volkswagen received $430 million (in 2017 dollars) to locate their first U.S. plant in Pennsylvania. Volkswagen chose Pennsylvania after narrowing down their search to thirteen states and receiving multiple rounds of bids. This subsidy included financial (e.g. property tax abatements, low-interest loans) as well as in-kind (e.g. rail and highway extensions, job training) incentives. Perhaps partly enticed by the success of Volkswagen, other foreign auto manufacturers followed, each spurring a subsidy competition between states.[12]

As in the 1980s, many subsidies in the last 20 years have gone to automobile manufacturers. However, recent subsidy deals also include R&D intensive industries such as pharmaceuticals and software, as well as wholesale trade, retail, and corporate headquarters. This may be a result of more companies actively seeking out subsidies from local governments, as "site selection" has become an industry of its own. A magazine by the same name gives companies information about expansion planning and subsidy deals, with a feature titled "Incentives Deal of the Month," which highlights deals other firms have received.[13] There are also consulting firms that specialize in site selection. Companies looking to relocate can hire a consultant to identify potential sites and negotiate subsidies

[12] Mazda located in Michigan in 1984 for $125 million, Mitsibushi and Toyota the next year in Kentucky ($147 million) and Illinois ($249 million) respectively. The VW deal is detailed in the book *The Last Entrepreneurs: America's Regional Wars for Jobs and Dollars* (Goodman, 1979). Information on the Mazda, Mitsubishi, and Toyota deals are from the *Good Jobs First* Subsidy Tracker (Mattera and Tarczynska, 2019). All of the state-level large deals tracked by *Good Jobs First* before 1987 are for foreign auto-manufacturers.

[13] *Site Selection* is not the only player, there is also *Business Facilities* (`https://businessfacilities.com/`), which markets themselves as "The leading source of intelligence for corporate site selection, expansion, relocation & area economic development solutions" and *Area Development* (`http://www.areadevelopment.com/`), "the leading executive magazine covering corporate site selection and relocation."

with local governments, advertised as "Public Incentive Identification & Negotiation." A company will often start with a list of 100s of potential sites, but, with the help of the consultants, narrow that list down to a much shorter list of the most attractive locations. This short-listed locations are then contacted and negotiations begin.[14]

The subsidy that a firm will receive is not a lump-sum payment from the governor, but sourced through various programs and state funds. One subsidy deal may consist of (1) tax credits and programs that the state already has in place to create jobs and investment, (2) tax abatements for the individual firm, (3) infrastructure projects, (4) low-cost loans, (5) job training programs, and (6) exemptions from state regulations. It often includes local level incentives as well, such as a property tax exemption. The governor and the state economic development agency decide the subsidy offer from the state, and the city and county decide the contribution from the local government. The state legislature (and city council) may need to approve the offer, or pass a bill to enact any specialized legislation for the firm.

There are significant differences across states and firms in the composition of subsidy deals. For example, consider Foxconn, an electronics manufacturing company that received a subsidy worth almost $5 billion dollars to locate a plant in Wisconsin. The deal consists of 15 years of corporate tax abatements, amounting to about $2.85 billion. Due to two existing tax credits Foxconn would have little to no state tax liability, and would receive the $2.85 billion in cash from the discretionary tax abatement. The state also agreed to make road improvements worth over $252 million, and give sales tax breaks for construction worth $150 million. The locality created a Tax Increment Financing district, which amounts to an additional $1.5 billion. Lastly, Foxconn was also exempted from various state environmental regulations, the savings from which are hard to measure.

In California, however, the aerospace and defense company Lockheed Martin received a subsidy composed entirely of two tax credits. California passed a new tax credit specifically for Lockheed, in exchange for locating their production of new bombers for the Air Force in the state. The legislature enacted the *New Advanced Strategic Aircraft Program*, which specifically gives a credit of 17% of wages to "qualified taxpayers that hire employees to manufacture certain property for the United

[14]Take, for example, a description of the site selection process for Volkswagen's 2008 assembly plant (Bruns, September 2008). "A team of 25 people with Staubach worked on the project, helping VW consider an initial pool of more than 100 candidate sites, all located in the central or eastern U.S. because of time-zone proximity to Germany. "What you look for is mostly problems sites have – readiness, labor, logistics infrastructure," says Greg Lubar, project leader and senior vice president at Staubach. VW said it short-listed 25 sites. "It was then a dozen or so we were in discussions with until the three finalists," says Lubar."

States Air Force." Lockheed also qualifies for California's R&D tax credit on any R&D expenses, which is the highest in the U.S. at 15%.[15] This is worth an estimated $420 million to Lockheed Martin.

2.2 Data

A difficulty for empirical research on state and local business incentives in general is the absence of a comprehensive and centralized data set of state taxes, incentives, and subsidies. States vary widely in the structure of their corporate and individual income taxes and payroll, not to mention their economic development and incentive programs. Also, states and local governments do not make the subsidies they offer to individual firms public knowledge.[16] To this end, most empirical work to this point has focused on posted tax rates or a single credit program at a time.[17] In order to evaluate subsidy competition I need the full picture of all the incentives offered. A major contribution of this paper is the introduction of a detailed data set on individual incentive deals.

Data Collection

The *Good Jobs First* Subsidy Tracker (Mattera and Tarczynska, 2019) collects data on state and local discretionary incentives from a variety of sources: state documents, FOIA requests, news articles, and press releases. If a state does not publish establishment level incentive spending, then the coverage for that state is not exhaustive. However, the Subsidy Tracker takes care to track the largest subsidy deals, due to publicity and media interest. For this reason, the *Good Jobs First* data cannot be used as a measure of the exact amount of tax credits and incentives each establishment in a state received, but is an extremely useful starting point to study large discretionary deals.

I start with the set of all Subsidy Tracker entries over $5 million. I then limit the sample to entries that involve a discretionary program or mention expansion or relocation. I then add any firm location decisions described in *Site Selection Magazine*'s annual "Top Deals" report. I arrive at a sample of

[15] Unlike at the federal level, state level R&D tax credits are used less to encourage innovation and more to attract businesses. In California, a report to the Council on Science and Technology reads " California is perceived as a high-tax business environment by firms contemplating setting up business or expanding...An R&D-related tax measure targets the particular types of firms that California desires to attract in spite of its relatively high position in the "tax" league tables."

[16] Recent examples include this New York Times article on transparency issues "Cities' Offers for Amazon Base Are Secrets Even to Many City Leaders," and the New York Times opinion piece by political scientist Nathan Jensen, "Do Taxpayers Know They Are Handing Out Billions to Corporations?"

[17] The notable exception being Suárez Serrato and Zidar (2018), who leverage the new database on tax rates and credits created by Bartik (2017).

over 500 establishments receiving discretionary subsidies over the period 2002-2017. At a minimum the *Good Jobs First* will include the company name, location, year, agency or program that gave the subsidy, and the value of the subsidy. The higher quality observations also include information on the number of jobs that will be created, wages, planned investment and the industry of the firm, as well as a description of the project and details breaking down the subsidy into its various components.

Appendix Figure A.5 shows the range in information available in the Subsidy Tracker. Toyo Tire agreed to locate their tire plant in Georgia and create 900 jobs at an average of $15 per hour. Toyo would also make a capital investment of $392 million. In exchange, they would receive $71 million from the state and county combined. The subsidy contains infrastructure, land, state tax credits, and exemption from certain state and local taxes. The only additional information that I need for the analysis is the runner-up location and the number of competitors in the subsidy competition. Meanwhile, the Subsidy Tracker reports that Microchip received a discretionary property tax abatement from the state of Oregon, worth $13 million, in 2002. From the project description I know that Microchip is a semiconductor firm. However, I do not know whether Microchip is a new entry to Oregon or expanding an existing facility, how many jobs they are creating, and whether they qualified for any existing non-discretionary state tax credits or programs.

In order to fill in the number of jobs and planned investment I take a brute-force approach, and read articles and press releases about each deal.[18] For the Microchip example, there is an article in the trade publication *Site Selection* titled "Oregon Incentives, Idle Plant Are 'Fab' for Microchip's Expansion Plan." From the article I learn how many jobs are planned (688) and the runner-up location (Puyallup, WA).[19] I also add any non-discretionary incentives that the firm would qualify for in the state, if it is not included in the subsidy entry or news article. I know each economic development program and tax credit available in a state because I download each tax expenditure report and budget document from state websites, creating a state-year-incentive program spending data set.[20] In Microchip's case, Oregon has a 5% R&D tax credit for eligible R&D spending, which would mean

[18] When there is no information on the industry of the firm I match the company name to Compustat, if not in Compustat it is also sourced from the news articles. Over 50% of the observations in the sample have missing jobs or investment, which I fill in.

[19] From the article: "Spurred by US$17.3 million in state incentives, Microchip Technology (www.microchip.com) has hired the first 60 of what may be as many as 688 employees at its newly acquired facility in Gresham, Ore....In 2000, Microchip bought an existing Matsushita fab in Puyallup, Wash., 155 miles (249 kilometers) north of Gresham. The Puyallup fab, which is also currently idle, was the clear frontrunner in Microchip's U.S. expansion plans."

[20] In the cases that these documents are not available online I call the state budget offices and request the document from the archive. See more details on the state level tax expenditure and economic development budget data in Appendix Section A.

an additional \$2.2 million in savings, given the number of jobs promised and average industry wage.

Runner-up locations are almost never included in the Subsidy Tracker entries, so creating an establishment-level subsidy dataset that includes the number of competitors and the identity of the runner-ups is a considerable task. Sources include *Site Selection* and other trade magazines, local newspapers, state documents, and company press releases.[21] I was able to find some information about the runner-up for 95% of the subsidy deals in my sample. Of course, the runner-up "location" is sometimes not a location but a threat to shut-down or not expand. In 77% of cases I can identify a runner-up location in the U.S.[22] The final sample that I use in this paper is the set of 387 subsidy deals for which I have evidence there was a competition for the project, I know the runner-up location, and the runner-up location is within the United States.

Lastly, I normalize all the amounts by the length of the subsidy deal. In the majority of deals firms receive tax credits or abatements for a period of 10 years, so I standardize all deals in the data to the 10-year value. The bulk of the new data comes in the form of the runner-up locations, number of competitors in the subsidy competition, non-discretionary incentive spending, promised job numbers, and planned investment amounts.[23]

Limitations of the Data

The ideal data set would consist of the detailed contract between the firm and state (or city), as well as administrative data on state, county, and city costs, and firm savings for each year following the deal. Of course, those data are confidential, and still might not include all of the variables I would like, for example, the dollar value of in-kind subsidy items to a given firm or the exact set of sites the firm was considering in the competition. In this section I will briefly discuss the limitations of the data I do have.

Good Jobs First takes the value of the deal as given from the source (state documents, news article, press release), and states may calculate the present discounted value differently, and include or exclude certain costs when reporting the value of the subsidy deal. Similarly, certain parts of the subsidy deal are in-kind, for example, the state gives the firm land or builds an exit to the highway.

[21] Collecting runner-up locations from *Site Selection* is at the heart of the identification strategy in Greenstone, Hornbeck and Moretti (2010). See examples from other sources in Appendix Section A.1.

[22] For about 10% of the sample the runner-up is outside of the U.S., and the remaining firms reportedly do not consider other locations, but claim that they would not expand or shut down without the subsidy.

[23] A comprehensive data appendix, with the list of sources and a description of each subsidy deal, is available from the author upon request.

I rely on the estimate from the state on how much that is worth, and no distinction is made between how much it costs for the state to provide and how much it is worth to the firm.[24]

In the analysis I will treat the jobs promised and the investment planned in the winning location as fixed in the competition. That is, if I observe a subsidy for BMW creating 2,000 jobs in South Carolina, I assume BMW was promising 2,000 jobs in all of the potential locations competing. For assembly plants this is likely close to reality, but it might not be the case for other types of establishments, like a regional headquarters. This type of measurement error can introduce bias in the estimate of firm profits and runner-up valuations, which I discuss further in Section 5.

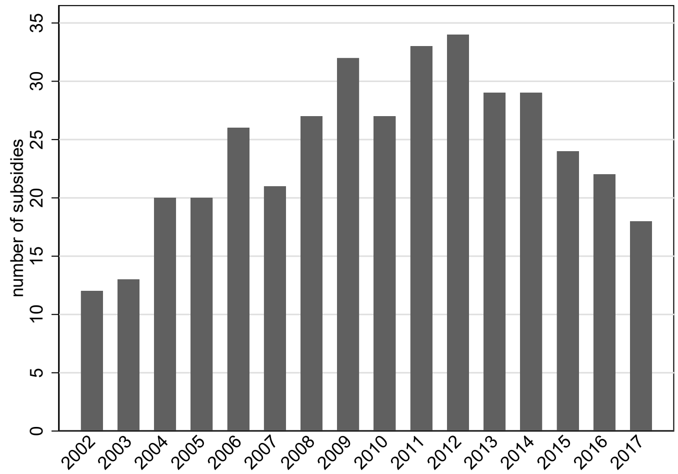
In terms of selection, I know the runner-up and winning location, and for the majority of the deals I know the number of locations competing for the firm. However, I do not necessarily know the identity of each of these competing locations. Therefore, in the counterfactual analysis, I will have to make an assumption on the set of locations the firm will choose between. I do not explicitly modeling entry, but I use characteristics of locations that enter the firm's profit function to select the set of locations, such as establishment concentration, wages, and housing prices. This is motivated by the institutional details on the site selection process, as described in the start of this section.

Another consideration is the selection of firms that receive subsidies. If a firm relocated without any discretionary subsidy it is not considered in this data set, because I do not have administrative data on establishment entry. Therefore, all of the analysis is with respect to this subset of "special" firms which receive discretionary subsidies. See Appendix A.3 for a discussion of various checks of the integrity and coverage of the *Good Jobs First* and *Site Selection* data.[25]

[24]Consider the two examples of subsidy deals I presented in Section 2.1. In the case of Foxconn, the subsidy deal reportedly included exemptions from state environmental regulations. I have no way to estimate how valuable that would be to Foxconn, and it is not included in the dollar amount of the deal. In the case of Lockheed Martin, the *Good Jobs First* data only includes the value of the discretionary tax credit, but Lockheed is also eligible for California's very generous R&D tax credit. I do not know the size of Lockheed's research and development expenses in California, so I will have to estimate the value of the credit using the number of jobs they will create, the expected wages of those jobs, and the proportion of R&D employment in that industry. Lockheed Martin is a publicly traded firm, so they do report their R&D expenditure to the SEC in the Form 10-K. However, this is not broken down by location of expenditure, and Lockheed operates "significant operations" in 22 locations across 16 states, according to their 2016 10-K.

[25]In Slattery and Zidar (2020) we compare the data collected for this paper with previous efforts and approaches to collect data on incentive spending and subsidy deals. In that paper, we use the same data, but we do not restrict the subsidies to deals for which we know there was a competition and we know the runner-up, therefore we have over 500 deals in the sample for the descriptive analysis.

Figure 1: Subsidy-giving by Year, 2002-2017



Notes: This figure shows the number of subsidy deals in the sample in each year. Subsidy-giving increased from 2002, at just over 10 deals, to 2012, with almost 35 deals. Data collected by the author.

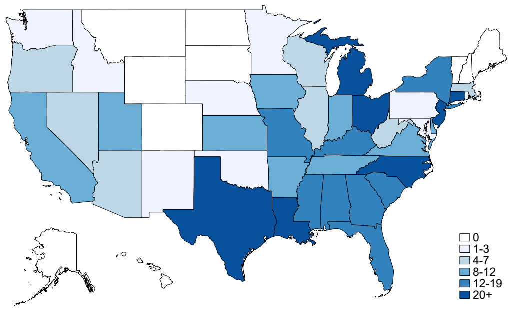
2.3 Descriptive Statistics

The number of discretionary subsidies per year has grown over the sample period: from just over 10 in 2002 to a peak of almost 35 in 2012 (Figure 1).[26] Over this period the size of the subsidies did not follow the same trend; there is substantial heterogeneity in total subsidy size and the subsidy cost per job within and across years, industries, and states. On average a firm receives a subsidy worth \$149.5 million over 10 years and promises to create just under 1,400 jobs. This amounts to about \$107,000 per job, or \$10,700 per job per year. At the 10$^{\text{th}}$ percentile the total cost per job is \$15,000, and at the 90$^{\text{th}}$ it is \$522,000.

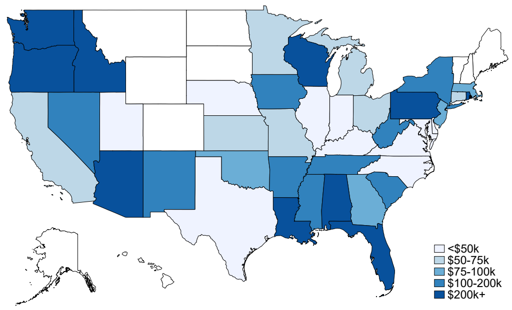
Figure 2 highlights geographic patterns in subsidy-giving, cost per job, total business incentive spending, and spending per establishment entry. Note that large states, such as Texas, California, and New York are all top incentive spenders (Panel c), but do not necessarily give the most discretionary subsidies (Panel a) or spend much per subsidy job (Panel b). When spending is normalized by the number of establishments with at least 100 employees that entered the state (Panel d), it is states such as Idaho, West Virginia and Oklahoma that are the top spenders. These are potentially less productive

[26]The lower number of subsidy deals in the last 2 years of the sample is not necessarily representative. The data were collected in 2018 and it can take more than a year before all of the information about the subsidy deal that I need is public information.

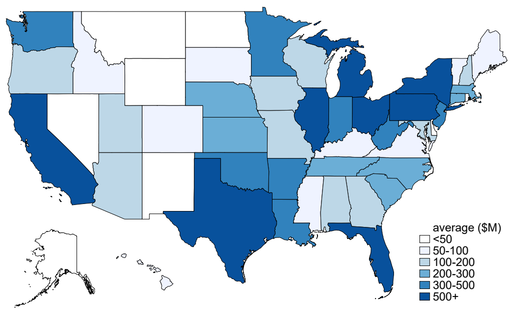
Figure 2: Geographic Distribution of Subsidy-Giving and Incentive Spending



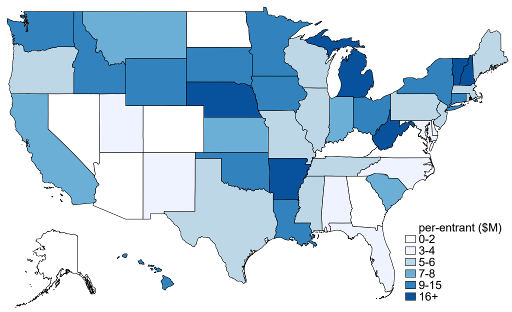
(a) Number of Subsidies



(b) Subsidy Cost Per Job



(c) Total Business Incentive Spending



(d) Spending Per Establishment

Notes: The four figures above show the geographic distribution of subsidy-giving and spending. Figure (a) is the number of subsidies given by each state over the sample period (2002-2017). Figure (b) is the average cost-per-job of subsidies given in each state. Figure (c) is the yearly average of each states' total business incentive spending, which is not limited to discretionary subsidies. Total business incentive spending includes all tax credits and economic development programs that the state has available to new and expanding businesses. Figure (d) is the average per-establishment incentive spending. This is calculated as the states' total economic development spending in year t, divided by the number of establishments with 100+ employees that entered the state in year t. Data on subsidies and total business incentive spending is collected by the author. Establishment entry is from the Census Business Dynamics Statistics data.

locations for new establishments, so firms require large incentives to locate there.[27]

There is also a considerable amount of heterogeneity in subsidy-giving across industries (Table 1). Over half of all subsidies in the sample go to firms in manufacturing industries, with subsidy deals for automobile manufacturers making up about 10% of all observations. Automobile manufacturers promise over 2,000 jobs per deal, so although they receive larger subsidies than average, the cost per automobile manufacturing job remains relatively modest. Meanwhile, subsidies in the chemical manufacturing and mining industries have extremely large cost per job numbers, promising low levels of direct employment and high levels of investment. It is also striking that dissimilar industries, such as management (headquarters) and transport/warehousing, receive similar size subsidies per job on

[27]Note that many smaller states are never observed giving large discretionary subsidies to firms. This may be due to budget constraints, which I discuss in Section 7. I provide more details on the state budget process in Appendix Section A.

Table 1: Terms of Subsidy Deals

Industry (NAICS)	# of Deals	Mean # Bidders	Subsidy ($M) Mean	Subsidy ($M) Med.	Jobs Promised Mean	Jobs Promised Med.	Invest ($M) Mean	Invest ($M) Med.	Cost/Job ($K) Mean	Cost/Job ($K) Med.
Mining, Utilities (21-22)	3	4.0	753.7	314.2	215	225	3,215	2,277	3,506	1,397
Manufacturing (31-33)	206	5.8	203.2	89.3	1,383	900	1,752	461	147	99
Chemical manuf. (3251-3)	15	2.6	293.6	186.8	314	180	1,943	1,255	936	1,038
Automobile manuf. (3361)	37	7.1	264.3	154.1	2,802	2,000	960	613	94	77
Aerospace manuf. (3364)	22	7.6	389.0	107.6	1,615	1,020	7,123	688	241	105
Wholesale, Retail Trade (42-45)	15	6.4	68.7	41.1	1,302	820	288	160	53	50
Transport/Warehousing (48-49)	13	3.0	82.2	69.3	1,887	1,050	232	228	44	66
Information Svc. (51)	27	6.6	85.1	74.4	730	450	612	171	117	165
Finance, Insurance, RE (52-53)	44	3.0	50.4	33.3	1,794	1,495	160	75	28	22
Financial activities (5239)	18	3.3	59.0	26.8	1,970	1,825	204	67	30	15
Prof., Scientific, Tech Svc. (54)	43	5.3	119.7	56.3	1,431	700	262	53	84	80
Scientific R&D (5417)	17	3.1	136.5	62.8	549	303	181	95	248	207
Management, Other Svc. (55-81)	36	3.8	55.4	37.5	1,432	972	189	90	39	39
Full sample	387	5.2	149.5	59.5	1,399	907	1,084	214	107	66

Notes: This table displays sector and industry level descriptive statistics on subsidy deals. For each industry group, the table presents the mean and median subsidy size, number of direct jobs promised by the firm (this includes new and retained jobs), and planned investment. I also list the number of subsidy deals in each category, and the average number of locations in competition for the firms in that category (the number of bidders). For large sectors (in terms of subsidy deals), such as manufacturing, I break out the statistics for certain industries. This is for a sample of large subsidy deals for which there was competition between localities and the runner-up location is known. The data were collected by the author. The sample period is 2002-2017.

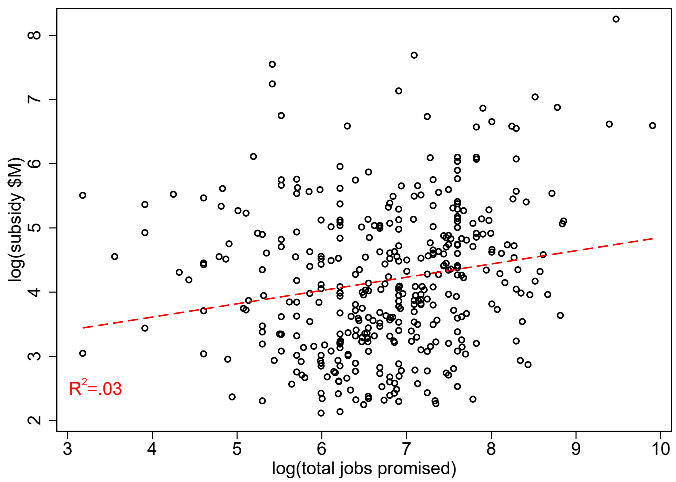
average, at $38,700 and $43,500 per job respectively. The question remains—what explains the generosity of any one subsidy deal?

The most commonly cited motivation for giving a discretionary subsidy is job creation. This is evident from both the legislative text and interviews with policymakers.[28] However, jobs do not go very far in explaining subsidy size. In Figure 3 I plot the total number of jobs promised by a firm with the size of the subsidy it received. For the majority of the sample, the relationship between jobs promised and subsidy size is fairly modest; an additional job is correlated with an $18,000 increase in subsidy size.[29]

[28]For example, the legislation enacting North Carolina's Job Development Investment Grant (JDIG) program states: "The purpose is to stimulate economic activity and to create new jobs for the citizens of the State by encouraging and promoting the expansion of existing business and industry within the State and by recruiting and attracting new business and industry to the State." In an interview with the Washington Post about the Amazon HQ2 bidding war, Maryland State Senate President Thomas 'Mike' Miller says "Whether in Baltimore City, Prince Georges County or Montgomery County, we need to make it happen. It's jobs, jobs, jobs and more jobs" (Nirappil and Wiggins, 2018).

[29]Total jobs promised includes the new jobs the firm promises to create and the jobs the firm promises to retain. When the subsidy deal is for an expansion then retained jobs are often part of the deal; the firm is promising to stay and expand in their current location, instead of picking up and moving elsewhere.

Figure 3: Total Jobs Promised vs. Subsidy Size



Notes: This figure plots the log number of jobs promised in a subsidy deal, with the log size of the subsidy the firm receives. Log jobs is on the x-axis, and subsidy size, in log($M), is on the y-axis. The red dashed line is the trend line, which has a R^2 of 0.03. An additional job is associated with an approximately $60,000 larger subsidy. However, when I drop the deals that promise over 10,000 jobs, which is the case for 3 deals (less than 1% of the sample), the correlation falls to about $18,000 per additional job. For the most part, it does not appear as though states only value job creation. Data collected by the author.

The unobserved indirect job creation of each firm, that is, jobs expected to be created through spillover, may help rationalize this lack of correlation between direct jobs and subsidy size. Spillovers are another oft-cited justification for the size of a subsidy or competition for a given firm, as well as a motivation for subsidy competition in the theory.[30] Heterogeneity between states, differing valuations of jobs in certain industries, revenue considerations, and economic conditions also could have a role in explaining subsidy size. I explore these possibilities in Table 2, with a linear regression of subsidy size on all of the observed "terms" of the subsidy deal, as well as on state and local characteristics.

The first three columns of Table 2 only consider deal-specific determinants of subsidy size: jobs promised, investment planned, and the local employment, or "jobs," multiplier. I use the local employment multipliers at the industry level to proxy the average expected spillover job creation.[31,32]

[30] However, there is limited data on firm-state specific spillovers. North Carolina provides predicted "indirect job creation" in the documentation of their discretionary grant program. They often estimate the indirect jobs created by attracting a given firm will be an order of magnitude greater than the direct jobs. See Figure A.3 in the Appendix.

[31] In a previous draft I explicitly model expected spillovers by estimating the effect of large firm location decisions on the location of smaller firms, in a discrete choice framework (Berry, 1994). Results available upon request.

[32] The multiplier represents the predicted number of jobs created in the local economy for every one new job in the industry.The Economic Policy Institute (EPI) uses Bureau of Economic Analysis data to create these employment multipliers. I check the EPI multipliers against the North Carolina data and find similar magnitudes. For example, North Carolina predicted that the pharmaceutical firm Novo Nordisk would have a jobs multiplier of 6.2, while the EPI reports

A promise of 1,000 more jobs is correlated with a \$25 million increase in subsidy size, an additional \$1 billion in investment is correlated with a \$38 million increase in subsidy size, and an increase of one additional indirect job per promised job is correlated with a \$11 million increase in subsidy size. Taken together, investment, jobs, and the jobs multiplier explain about one-third of the variation in observed subsidies.

If firms create different value across space, state and local governments should vary in their willingness-to-pay for an identical establishment. This could be due to the expected revenue from new economic activity—a state with a higher corporate income tax can expect to collect more revenue from increased business activity in the state. It could also be due to differences in the value of a new job—local residents who are employed at the new establishments will enjoy welfare gains that depend on their prior wages and employment status.[33] Column 4 of Table 2 considers the location characteristics that might affect the state and local governments' willingness-to-pay for the firm. This includes tax rates, the local unemployment rate, and per capita income. A one percentage point increase in the unemployment rate in the winning county of the subsidy deal is correlated with a \$14 million increase in the subsidy size, but on their own, location characteristics that might explain willingness to pay only explain 8% of the variation in observed subsidy size.[34]

Column 5 of Table 2 displays the correlation between subsidy size and the location characteristics that the firm might consider when making their location decision. If the firm has a lower expected productivity in a given location, they should demand a larger subsidy to compensate them for not going to a higher productivity location, all else equal. For example, firms value certain pro-business policies, such as right-to-work laws (Holmes, 1998), so they are willing to accept lower subsidies in right-to-work states. The same is true for local amenities, such as whether there is a research university, or airport, in the county. In the final specification I include all of the variables: deal characteristics that affect how much a firm's establishment is worth to a locality, location characteristics that affect the state and local government's willingness to pay, and location characteristics that affect the firm's location decision.

Table 2 provides insights on how firm characteristics, government willingness-to-pay, and location profitability can affect subsidy size. Of course, there is one important element missing in this

a multiplier of 5.7 for the pharmaceutical industry.

[33] In Slattery and Zidar (2020) we show that in the aggregate higher corporate tax rates are correlated with higher per-capita business incentives. We also show that in the individual subsidy data, poorer counties pay more per job.

[34] Appendix Table A.2 shows how state-level economic and political characteristics correlate with per capita business incentive spending, using the state level data.

Table 2: Reduced Form Evidence: Determinants of Subsidy Size

	Dependent variable: Subsidy ($M)					
	(1)	(2)	(3)	(4)	(5)	(6)
Deal Characteristics:						
Direct Jobs Promised (1,000)	30.37	27.94	25.48			28.09
	(6.18)	(5.52)	(5.39)			(5.53)
Investment Planned ($B)		40.38	38.03			38.32
		(4.17)	(4.07)			(4.07)
Jobs Multiplier			10.82			8.42
			(2.24)			(2.35)
State Characteristics:						
Corp. Tax Rate (%)				13.61	8.72	12.68
				(4.91)	(4.95)	(4.38)
Income Tax Rate (%)				-17.07	-16.09	-15.12
				(4.51)	(4.74)	(4.19)
Right-to-Work					-22.21	4.76
					(23.29)	(22.28)
Local Characteristics:						
Unemp. Rate (%)				13.61		5.50
				(7.43)		(6.72)
Per Cap Income ($1,000)				-2.03		-0.44
				(1.29)		(2.00)
Concentration of Industry Estab.					-37.55	-8.80
					(16.09)	(14.43)
Local Industry Wage ($1,000)					0.22	0.00
					(0.29)	(0.25)
House Prices ($1,000)					0.03	0.00
					(0.14)	(0.16)
Research University					-33.38	-4.31
					(26.70)	(23.06)
Airport					-28.48	-35.26
					(25.66)	(22.47)
Observations	384	384	384	384	384	384
R-squared	0.08	0.27	0.31	0.08	0.09	0.36

Notes: This table presents the results of a linear regression of subsidy size on subsidy deal characteristics, state characteristics, and local (commuting zone) characteristics. The coefficients represent correlations between observed subsidy size and observed characteristics. Each observation is a subsidy deal, the sample is 2002-2017, and regressions include year fixed effects. The sample is restricted to subsidies under $2 billion, which means that 3 subsidy deals with extremely large subsidies (Boeing $\times$ 2, Foxconn) are not included. Data on promised jobs, investment, subsidy size, and industry of the firm are compiled by the author. The jobs multiplier is from the Economic Policy Institute (2019). Sources for state and local characteristics include the CSG Book of the States (1950-2018) (tax rates), U.S. Bureau of Economic Analysis (1967-2017) (per capita income), National Conference of State Legislatures (2019) (right-to-work), Bureau of Labor Statistics (1990-2017) (unemployment), County Business Patterns (1997-2017) (establishments, wages), National Science Foundation (2000-2017) (research universities), Zillow (1996-2020) (housing prices), and Federal Aviation Administration (2019) (airports).

analysis: competition. The observed subsidy size is not only a function of the profitability of the location and the local government's willingness-to-pay, it is a result of competition between locations. In order to incorporate competition, I introduce the model.

3 Model

In this section I develop a model of subsidy competition. I use anecdotal evidence from reporting on subsidy deals and the site selection process, institutional details from internal reports, and discussions with state economic development agencies and company officials to inform my modeling approach. To be specific, I model subsidy competition as a private value open outcry ascending (English) scoring auction. Recent work on consumer loan and mortgage markets take a similar approach, as markets with negotiated prices often resemble English Auctions (Allen, Clark and Houde, 2019; Cuesta and Sepúlveda, 2019). For example, Cuesta and Sepúlveda (2019) use an English auction to model the process in which consumers shop across banks for the best contract offer. The consumer signs the contract with the lowest cost bank, at the interest rate that leaves the second-lowest cost bank with zero profits. In my setting, firms "shop" across locations for the highest payoff (the sum of the location-specific profit and the subsidy offer). Firms can use other locations' offers to negotiate better subsidy deals, just like a consumer shopping for loans. Then, the firm will locate in the highest payoff location, with a subsidy that leaves the second-highest payoff location with a zero payoff.

The English Auction captures many real world features of subsidy competition in the United States. First, firms do not always locate in the highest subsidy place, they care about other location characteristics that affect their profits, like human capital, wages, and labor laws. Therefore, we can think of the competition as a scoring auction, where the locations submit bids which are scored on subsidy (traditionally, this is price) and profit (traditionally, this is quality). As noted in the introduction, many of the subsidy offers that Amazon received were larger than the subsidies offered by the winning locations.[35]

Second, there are often multiple rounds of bidding in a subsidy competition. That means that a local government can submit one subsidy offer, then, after learning that they are still not the highest payoff place, offer a larger subsidy. This is why I chose the ascending auction—the bidder (local

[35] I usually do not have data on the size of the subsidy in the runner-up, but this is also true for the Hyundai plant in Alabama (2002), the Samsung plant in Texas (2006), and the Foxconn factory in Wisconsin (2017), among others.

government) can increase its bid over the course of the auction.[36]

The third institutional detail that I capture is that local governments know the subsidy offers of their competitors.[37] In the auction framework this is an open outcry auction. This is an important feature, because it disciplines the bidders to increase their bids only when they know they have been outbid, and the current bid is lower than their valuation. The open-outcry ascending auction is also called an "English" auction, and is strategically equivalent to the second price auction.

The last feature of the auction is that it is private value. In this context, this means that the states know with certainty the benefit or value the firm will create in the state. This value is state-specific, the firm is not expected to create the same amount of value in each locality. This is the crux of the allocative efficiency argument—competition can improve the allocation of firms to localities if localities have different values for a job, or different agglomeration externalities. There may be some correlation in valuations, based on firm characteristics. This is incorporated in the model, states draw a valuation conditional on firm observables.[38]

To summarize, I will use a private value English scoring auction to model the subsidy competition. Bidding for a firm begins when the firm contacts the states it is considering for an expansion or relocation, and continues as states learn of other bids and adjust their subsidy offers. The firms that are being "auctioned" have a discrete choice problem; they locate in the state that gives the highest payoff, where payoff is a function of the subsidy offer and the profit they would receive in that state.

The model captures the mechanism through which states compete for firms, and allows me to clearly separate the government valuation for firms and the firm preferences over locations. This will allow me to explain how locations make subsidy decisions, and how subsidies influence firm locations.

3.1 Model Set-up

There are two types of agents in the model: State (and local) Governments and Firms that receive discretionary subsidies.[39]

[36]Firms and consultants often cite being in "discussions" with multiple locations throughout the site selection process. Over this time the locations can refine the subsidy offer.

[37]See Appendix Section B for evidence of this assumption.

[38]See Section 7 for an extended discussion of this assumption.

[39]Throughout this section I will simplify by using the word "State" to denote the state and local government. In reality, the state and local government may both contribute to the subsidy deal, and the "state" valuation for the firm will depend on the specific location within the state that the firm is considering locating. I allow for this in estimation, but stick to the

The state, s, has a value for each firm, denoted v_{is}. The value a firm brings to the state, v, can depend on a variety of factors, including the revenue the state and municipality anticipate receiving from increased tax collections as well as any positive externalities the firm is predicted to create create via increasing demand for services, attracting other firms, or increasing local housing prices. It can include negative things about winning the competition for a firm, e.g. negative externalities (congestion) and cost of raising funds. One can think of the valuation for a firm to be a function of location and firm characteristics, x and z, such as the per capita income in the location and the number of jobs promised, as discussed in Section 2.2. However, this function may differ substantially across locations. Given the heterogeneity across states in the spillover and revenue impact of any given firm, this is modeled as a private valuation—the benefit of firm i locating in state s is different across states, given the firm characteristics.

The firm, i, has a profitability in each location, denoted π_{is}. This will also be a function of location and firm characteristics, x and z, such as the wages and taxes in the location, and the size of the planned investment of the firm.

3.2 Example: Auction with 2 States

I will illustrate how the auction for firms works with a simple example (also shown in a diagram in Figure 4). Suppose there are two states, State 1 and State 2, competing for a firm, Firm A. Firm A has a profit of \$10 million in State 1, which values Firm A at \$3 million, $\{\pi_{A1}, v_{A1}\} = \{10, 3\}$. In State 2, $\{\pi_{A2}, v_{A2}\} = \{7, 7\}$.

In absence of subsidy competition, Firm A would locate in the state that gives the highest profit, State 1, receiving a payoff of \$10 million. State 1 would receive their value for the firm, \$3 million, for a total welfare ($\pi + v$) of \$13 million.

If the states compete for the firm in an English auction, State 2 can start the bidding with a subsidy offer of \$3 million + ε, making the payoff Firm A would receive in State 2 ε higher than its' payoff in State 1. However, State 1 can respond to that; and states will continue to increase their subsidy bids until one of the states reaches its valuation for the firm. In this example, it is State 1, which will not bid higher than its valuation for the firm, \$3 million. Firm A receives a payoff of \$13 million in State 1 when it bids up the subsidy to its total value; State 2 responds by offering a payoff that is ε

state as the relevant location in the model to simplify notation.

Figure 4: Subsidy Competition Example with 2 States

State 1	**State 2**
$\pi_{A1} = 10, v_{A1} = 3, W = 13$	$\pi_{A2} = 7, v_{A2} = 7, W = 14$
$\vdots$	$b_2 = 3 + \varepsilon$
	$\pi_{A2} + b_2 = 10 + \varepsilon$
$b_1 = v_{A1} = 3$	$\vdots$
$\pi_{A1} + v_{A1} = 13$	$b_2 = 6 + \varepsilon$
- - - - - - - stop - - - - - - -	$\pi_{A2} + b_2 = 13 + \varepsilon$

Notes: This figure diagrams an example of subsidy competition between two states.

higher than \$13 million, which means it offers a subsidy of \$6 million + ε. Therefore, State 2 offers the highest payoff for Firm A, and Firm A locates in State 2.

Note that the total welfare when Firm A locates in State 2 is \$14 million; welfare has increased due to subsidy competition. Therefore, in this simple example, subsidy competition is not a zero-sum game. This is due, in part, to heterogeneity in the state valuations for the firm. Competition allows the state that would experience a larger benefit from the firm's entry to compensate the firm for its location-specific externality.

In this example, subsidy competition reduces the total payoff captured by the states. Without competition, State 1 received a payoff of \$3 million, its total valuation for Firm A. With competition, State 2 has a payoff of $v_{2A} - b_2 = 1 - \varepsilon$, just under \$1 million. Therefore, although total welfare increases with competition, this welfare gain is captured by the firm, and total state welfare decreases. If the difference in the two states' valuations were larger, both state and firm payoffs could increase under competition. The distribution of any welfare gain between the firm and the state depends on not only the welfare in the winning location, but the valuation in the runner-up.

One could easily formulate an example where competition is a zero-sum game. Consider the same case as the example above, except that the valuation of State 2 is \$5 million instead of \$7 million. Competition would still result in Firm A locating in State 1, but more rent would be transferred from the state to the firm. It is the correlation between π and v that dictate whether allowing competition will change the location decisions of the firm.

In Appendix C I generalize this example, and use the model to predict the change in welfare and division of welfare gain, under different assumptions on the number of bidders and the joint distribution of v and π. The results of the model simulations corroborate the predictions from the simple example. Appendix Figure C.1 shows how the share of simulated deals with a strictly positive welfare gain (e.g. the share of cases where allowing competition induced the firm to choose a higher welfare location) changes with the covariance of v and π (left panel) and the variance of v (right panel). As the covariance between v and π grows the highest profit place is more likely to be the highest welfare place, decreasing the share of deals that induce firms to choose a different location.

I also use the simulations to predict the split in welfare between firms and states. Appendix Figure C.4 shows that welfare gain captured by the firm increases with the covariance of π and v, and decreases with the variance of v. The goal of this paper is to estimate the distribution of π and v with the subsidy data, in order to quantify the welfare gains from subsidy competition and the distribution of the welfare gain between firms and states.

Now I will provide model details and formal notation.

3.3 Model Details

I will start with the timing of the game and then detail the optimization problem for each agent. The timing of the game is as follows:

(t=0) *Firms* contact states $s \in S$ about possibility of expanding in their jurisdiction.[40,41]

(t=1) *State governments* bid for firms.

Firms locate in state with highest payoff.

State Problem

A state $s \in \{1, \ldots, S\}$ draws a profit level and a private valuation for firm i, $\{\pi_{is}, v_{is}\}$, from the joint distribution $H_{\Pi,V}(\pi, v|z)$. The sum of profit and valuation, $w_{is} = \pi_{is} + v_{is}$, represents the total welfare created if firm i locates in state s. Total welfare across locations, conditional on firm characteristics, is distributed i.i.d. $F(w|z)$.

[40] I treat the set of locations S that the firm chooses to consider for their location problem as exogenous. One can think of a (t=-1) stage where the firm first decides to expand/relocate and determines the set of potential locations. This follows the institutional details of the site selection process, as discussed in Section 2.2.

[41] Multiple firms may conduct searches and choose locations each year (and at different times within a year). I assume there are no immediate synergies between firms; winning one auction does not explicitly increase (or decrease) my willingness to pay for the second firm. However, to the extent that winning a firm changes a location's characteristics, I allow this in estimation. Therefore, winning a firm can indirectly have an effect on both the probability of winning future deals and the state's valuation of subsequent firms. I will discuss this further in Section 7.

States compete for the firm in a private valuation English auction. The English auction is a open-outcry ascending auction, which means that a state can announce a bid and then increase their bid once another state makes a more attractive offer.[42] This is strategically equivalent to the 2nd price auction, in which every bidder bids their value, and the highest value bidder wins the good, paying the price of the second highest bidder. The optimal strategy for the state is straightforward—it bids up to its value, v_{si}, for the firm.

If firm i chooses to locate in state s the state receives a payoff of $v_{is} - b_{is}$, where b_{is} is the subsidy paid to the firm.

Firm Location Choice

The firm's objective is to maximize payoffs. This means that the winning state is not always the one with the highest subsidy offer. Instead the firm will locate in the state that gives them the highest payoff, the sum of their profit in the state and the subsidy offered by the state.

I model firm i's payoff from locating in state s as:

$$p_{is} = b_{is} + \pi_{is} \tag{1}$$

where b_{is} is the observed bid (subsidy offer) of state s, and π_{is} is the profit of firm i in state s.

Firm i locates in s if it gives the highest payoff of all states in S:

$$y_{is} = \mathbb{1}[\underbrace{b_{is} + \pi_{is}}_{p_{is}} \geq \underbrace{b_{im} + \pi_{im}}_{p_{im}} \ \forall\ m \in S].$$

Outcome

The outcome of the model is a set of equilibrium subsidies and firm locations, $\{b^*_{is}, y^*_{is}\}$ s.t.

$$\begin{aligned} \text{losing subsidy offers:} \quad & b^*_{ij} = v_{ij}(x_j, z_i) \\ \text{winning subsidies:} \quad & b^*_{is} \leq v_{is}(x_s, z_i) \\ \text{locations:} \quad & y^*_{is} = \mathbb{1}[\pi_{is} + b^*_{is} \geq \pi_{ij} + b^*_{ij}] \ \forall\ j \in S. \end{aligned}$$

[42] As the firm receives subsidy offers, it updates the competing states about whether or not they are still offering the highest payoff. I will discuss this assumption further in the next section.

4 Identification

The primitives from the model that I would like to identify is the joint distribution of profits and valuations $H_{\Pi,V}(\pi, v|z)$. I have data on firm locations, winning subsidy bids, runner-up locations, and location and firm characteristics.

Identification challenges arise because I only have data on winning subsidies, which do not represent the winning bids, therefore do not represent the second highest valuation in the auction. If firms only cared about the subsidy, and not other state characteristics, this would be a straightforward problem.[43] However, because locations compete on payoffs, and I do not observe the winning payoff, there are multiple steps.

In the first step I recover the parameters of the firm profit function and the runner-up valuation. I use the model outcome, which says the winning location should give the firm the same payoff as the runner-up. The observed winning bid is equal to the difference in the firm profits in the runner-up and winning locations, plus the runner-up subsidy. I observe the identity of the runner-up, which means that given functional form assumptions, I can identify the profit parameters and the runner-up's willingness-to-pay using variation in winning subsidies, the differences in runner-up and winning location characteristics, and the runner-up location characteristics.

In the second step, I use the estimated profits and valuations to calculate the welfare in the runner-up location. This allows me to apply the order statistic identity, and recover the full distribution of welfare. Finally, because total welfare is a function of state valuations and firm profits, I can exploit the relationship between profits and valuation in the runner-up states to invert the distribution of welfare and recover the marginal distribution of state valuations for firms. I take the rest of the section to provide intuition and details.

4.1 Firm Profits

From the model we know that firm i goes to the state (bidder) that gives the highest payoff. We also know the optimal bidding strategy of each state is to offer a subsidy up to their value, until no other state can raise their bid. This means that the winning state can stop bidding when the payoff they

[43] I would not need to recover profits, and the winning subsidy would represent the second order statistic from the distribution of state valuations. Therefore, identification of the distribution of valuations would be achieved using the order statistic identity (Athey and Haile, 2002).

give the firm just exceeds the welfare in the runner-up state. Essentially this is an auction on "total welfare," and, like the second price auction, the winning state will guarantee the firm the 2nd highest welfare:

$$\underbrace{\pi_{\text{winner}} + b_{\text{winner}}}_{\text{payoff in winning location}} = \underbrace{\pi_{\text{runner-up}} + v_{\text{runner-up}}}_{\text{welfare in runner-up location}} \tag{2}$$

To formalize the argument, I assume:

Assumption 1 *States compete for firm i in a private-value English auction. In this auction, the seller (firm) updates the bidders (states) when their offer has been dominated.*

As discussed in the start of Section 3, states learn competitors' subsidy offers through discussions with the firm (see Appendix Section B for evidence). Therefore, I am assuming that the firm is truthful about which location is most desirable throughout the auction process. I have discussed the issue of non-truthful firms with state economic development agencies. In the event that states are suspicious the firm is not accurately representing the alternative options, many agencies request documentation of both offers from other locations and costs in other locations to verify a firm's claims.[44]

Assumption 1 gives way to the following result:

Proposition 1 *The winning location will bid up to the firm's payoff in the runner-up location. Therefore, if firm i locates in location 1, the payoff they get in location 1 is equal to the payoff in the runner-up location (location 2):*

$$b_{i1}^* + \pi_{i1} = b_{i2} + \pi_{i2} \tag{3}$$

This is given from the structure of the English Auction, winning location (location 1) will never offer a subsidy higher than b_{i1}^*, as defined in Equation 3, because it will not change the probability of winning, but it will lower their payoff, $v_{1i} - b_{i1}$.

In the English Auction all losing states must have offered subsidies equal to their valuations, which is their stopping rule. This means that $b_{i2} = v_{i2}$ and I can rewrite Equation 3 as:

$$b_{i1} = v_{i2} + \pi_{i2} - \pi_{i1}. \tag{4}$$

[44] Alternatively, I could assume that states observe both subsidy offers from competing states, $\mathbf{b}$ *and* firm profits across all states, $\boldsymbol{\pi}$. The more demanding assumption, perhaps, is that states know what the firm's profit would be in each state. If there is asymmetric information in profits, the state may not know the payoff they have to offer the firm to ensure they win the competition, causing them to "overbid". However, given the state has a long history of competing for firms and observing location choices, as well as access to financial information for publicly traded firms, this is not necessarily far from reality.

Of course, Equation 4 is a function of both profits and valuations, two primitives that I do not observe. Here, I will parameterize the firm profit function.

Assumption 2 *Firm profits in locality c, state s, take the following functional form*

$$\pi_{ics} = \beta_i x_{cs} + \xi_{ics}$$

where x_{cs} are observed location characteristics, $\beta_i = \beta z_i$ where z_i are observed firm characteristics, and ξ_{ics} is the unobserved firm-location productivity match.

Along with profits, an object of interest is the location-specific valuation for the firm, v. Here I make an assumption on the functional form for the runner-up valuation. This is not necessary to identify the runner-up valuation, but crucial to start to understand how states make subsidy-setting decisions. Whether or not states offer subsidies based on jobs and spillover, or re-election concerns, will have implications for how we evaluate this policy (Glaeser, 2001).

Assumption 3 *Runner-up valuation takes the following functional form:*

$$v_{i2} = \alpha_1 x_2 + \alpha_2 z_i + \alpha_3 x_2 \cdot z_i + \varepsilon_{i2} \tag{5}$$

where x_2 are observed runner-up location characteristics, z_i are observed firm characteristics, and ε is the unobserved location-firm specific valuation.

Given Assumptions 1 through 3 I can write down winning subsidies as the difference in observed runner-up and winning location characteristics, runner-up location characteristics, firm characteristics, and the difference in unobserved location productivity matches, as well as the unobserved runner-up valuation.[45] In other words, I can plug in equations (4) and (5) into equation (3):

$$\underbrace{\beta_i x_1 + \xi_{i1}}_{\pi_{i1}} + b_{1i} = \underbrace{\beta_i x_2 + \xi_{i2}}_{\pi_{i2}} + \underbrace{\alpha_1 x_2 + \alpha_2 z_i + \alpha_3 x_2 \cdot z_i + \varepsilon_{i2}}_{v_{2i}}$$

and rearrange terms:

$$b_{1i} = \beta_i (x_2 - x_1) + \alpha x_2 + \gamma z_i + \phi (x_2 \times z_i) + \underbrace{(\xi_{i2} - \xi_{i1}) + \varepsilon_{i2}}_{\theta_i}. \tag{6}$$

Therefore, variation in winning subsidies and runner-up and winning location characteristics, identify the parameters of the firm profit function, β, given the following assumption on the orthogonality of the observed and unobserved variables:

[45]Note that this expression for v_{i2} is just for the specific runner-up location in the auction for firm i. Different locations may put different weights on firm and location characteristics. I can recover the average $\hat{\alpha}$ but will not be using these parameters to predict non-runner-up valuations.

Assumption 4 $(x_2 - x_1), x_2, z_i \perp \theta_i$, *where* $\theta_i = (\xi_{i2} - \xi_{i1}) + \varepsilon_{i2}$.

In words, I need the difference in the observed runner-up and winning location characteristics, the observed runner-up location characteristics, and the observed firm characteristics to be orthogonal to the sum of the difference in the unobserved runner-up and winning location firm profit match, as well as to the runner-up unobserved valuation.

Selection issues can arise if the unobserved valuation (or the unobserved difference in profitability) is correlated with observed characteristics. In particular, one might worry that a runner-up location that is less profitable to the firm, e.g. less attractive x_2, has a higher unobserved valuation, ε_2, for the firm. If this is the case, the estimates of β will be downward biased. Note that Assumption 4 concerns correlation between $x_2 - x_1$ and ε_2. There is less intuition for a correlation between x_1 and ε_2. The profit parameter, β, is estimated off of the difference $x_2 - x_1$, which slightly reduces the potential for bias due to correlation between x_2 and ε_2. However, it is still a consideration and will be discussed further in Section 7.

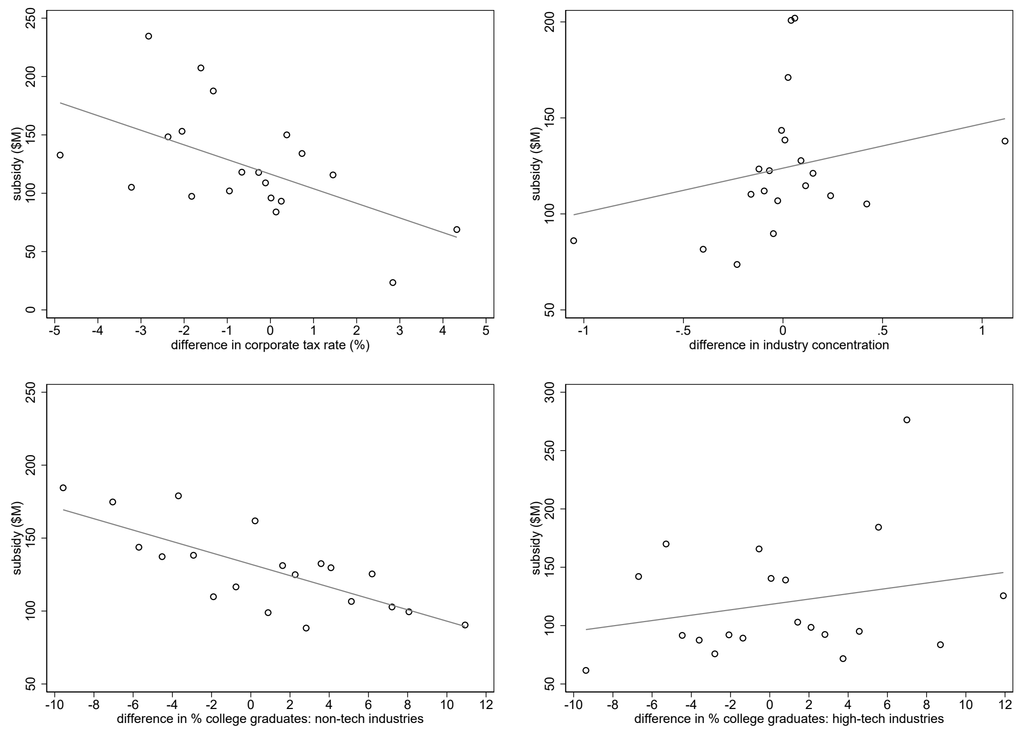
To see the intuition for this approach, imagine two subsidy deals for two automobile manufacturing plants of identical size. One plant locates in Alabama with a subsidy of $100 million and the other locates in Ohio with a subsidy of $140 million. In both cases, the runner-up in the subsidy competition is South Carolina, so the runner-up valuation and profit are held constant. Now suppose Alabama and Ohio have almost all of the same location characteristics: the same tax rate, the same wages, the same skilled workforce. The only difference between the two states is that Alabama is a right to work state and Ohio is not. Then, the $40 million difference in the two observed subsidy deals can be attributed to how much automobile manufacturers prefer to locate in a right to work state.

Figure 5 presents the graphical representation of this identification strategy for a subset of variables that enter the firm profit function or the state's valuation for firms. Each figure is a binned scatter plot, which controls for the other variables that enter profits and state's valuation. Therefore, the figure on the top left shows the relationship between the observed winning subsidy and the difference in the corporate tax rate in the runner-up and winning location, holding other location and firm characteristics constant. This shows a negative relationship between winning location tax rates and subsidy size. As the winning state's taxes decreases relative to the runner-up, the subsidy size decreases, as the relative profitability of the location has increased.

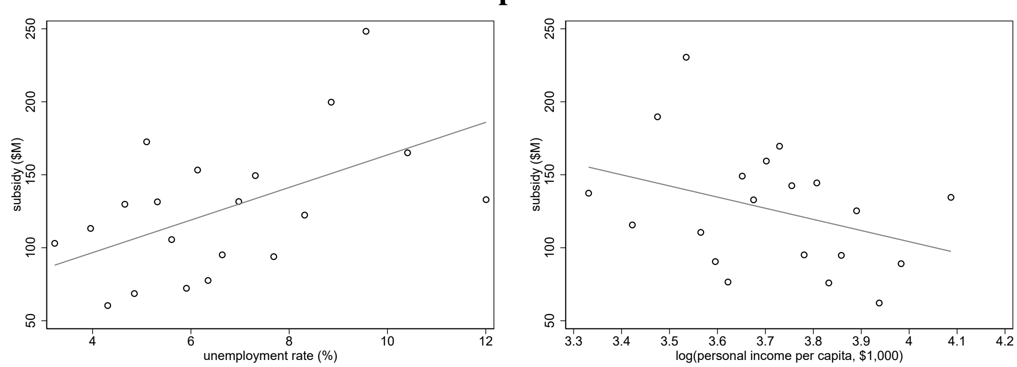
Given the estimates of β, I can use the out-of-sample (non winner or runner-up) location char-

Figure 5: Identification via Runner-up

Firm Profits



Runner-up Valuation



Notes: These figures show the variation in the data that allow me to identify the parameters of the profit function and runner-up valuation. Each figure is a binned scatter plot, which controls for the other differences in location characteristics, firm characteristics, and runner-up location characteristics (equation 6). The first four panels show the relationship between the observed winning subsidy and the difference between the runner-up and winning location characteristics that may enter the firm's profit function. The bottom two panels show the relationship between the observed winning subsidy and the runner-up location characteristics that may affect the runner-up's valuation.

acteristics, x, to predict firm profits across competing locations: $\hat{\pi}_{is} = \hat{\beta} z_i x_s + \xi_{is}$, giving way to an empirical marginal distribution for profits $\hat{H}_\pi$. [46]

4.2 Welfare

Given the parameters of the firm profit function and of the runner-up valuation, I have the empirical joint distribution of runner-up profits and valuations, and I can calculate welfare in the runner-up location:

$$w_{i2} = \underbrace{\hat{\beta}_i x_2 + \xi_{i2}}_{\pi_{i2}} + \underbrace{\hat{\alpha} x_2 + \hat{\gamma} z_i + \hat{\phi}(x_2 \times z_i) + \varepsilon_{i2}}_{v_{2i}} \tag{7}$$

The issue remains that I do not observe ξ or ε. The residual from equation 6, $\hat{\theta}$, takes the following form:

$$\hat{\theta}_i = (\xi_{i2} - \xi_{i1}) + \varepsilon_{i2}.$$

The residual includes both an unobserved state-firm productivity match, ξ, from the firm profit function, and an unobserved state-firm value match, ε, from the runner-up state's valuation. I do not have any more data to leverage here—I would need multiple observations of the same firm and location, or same firm and runner-up.

I will proceed in one of two ways. In the first specification I will assume that there are no unobservables, all of the relevant variables that affect firm profits and state valuations are included in z and x. In terms of notation, this means that when I estimate equation 6 the residual will be entirely attributed to measurement error; I am assuming $\xi = 0$ and $\varepsilon = 0$.

In the second specification I assume that the unobservable portion of profits and valuation, ξ and ε, are jointly normally distributed with the same covariance that is estimated in the observable portion of runner-up profits and valuations: $cov(\xi, \varepsilon) = cov(\hat{\beta}_i x_2, \hat{\alpha} x_2 + \hat{\gamma} z_i + \hat{\phi}(x_2 \times z_i))$.

The estimates of welfare in the runner-up locations give way to the distribution of the second order statistic of welfare $F(w|z)^{(2:n)}$. The last assumption that I need to make before proceeding to the estimation is that the total welfare across space is identically and independently distributed conditional on z, with distribution F. This was introduced in the model (Section 3.1), and is restated

[46] Recall that the site selection process, described in Section 2.2, generally involves a first round of screening, where the company might start with 100s of potential locations and then narrows the list down to a handful of the most attractive locations (the mean in the data is 5.2). Then, the company proceeds to negotiate with this set of finalists on the subsidy packages. Therefore the marginal distribution of profits, $\hat{H}_\pi$, will be a function of these relevant locations. I will address this in estimation (Section 5.4).

below:

Assumption 5 *Welfare across locations, w, is distributed i.i.d.* $F(w|z)$.

I can nonparametrically identify the distribution $F(w|z)$, using the distribution of runner-up welfare, $F(w|z)^{(2:n)}$. Identification of $F(w|z)$ comes from the order statistic identity. The i-th order statistic from an i.i.d. sample of size n from an arbitrary distribution F has distribution (Arnold, Balakrishnan and Nagaraja, 1992; Athey and Haile, 2002):

$$F^{(i:n)}(w|z) = \frac{n!}{(n-i)!(i-1)!}\int_0^{F(w|z)} t^{i-1}(1-t)^{n-i}dt \tag{8}$$

where n is the number of bidders. Therefore the distribution of welfare in all states, $F(w|z)$, is identified from data on the 2nd order statistic of welfare, $w_i^{(2:n)}$.

Number of Bidders

Equation 8 requires knowledge of the number of bidders in the competition. I have data on the number of bidders for over 90% of the sample. For the subsample of observations for which I do not know the number of bidders, I use the mean from the data, which is 5. The median number of bidders in the sample is 3. As the number of bidders is fairly low in most cases, for 50% of the sample I not only know the number of bidders but I also know the identities.[47]

Given the identification of the parameters of the profit function and the distribution of welfare, I proceed to the final object of interest, the marginal distribution of the state valuation of firms, $H_V(v|z)$.

4.3 Valuations for Firms

Recall, the goal is to identify the joint distribution of firm profits and state valuations $H_{\Pi,V}(\pi, v|z)$. From the model, I know the relationship between welfare (w), profits (π) and state valuations for the firm (v): $w = v + \pi \sim F$. From Section 4.2, I know the distribution of welfare, $F(w|z)$. From Section 4.1, I know the marginal distribution of profits, $H_\Pi(\pi|z)$. I also can approximate the joint distribution of runner-up profits and runner-up valuations, $\hat{H}_{\Pi V}^{runner-up}$. The challenge remains to recover the joint distribution of firm profits and government valuations across locations.[48]

[47] See Appendix Figure A.6 for the distribution of number of bidders in the data.

[48] We know that profits and valuations were independently distributed then the probability density function of the sum of dependent random variables is equivalent to the product of the transforms of each random variable (Springer, 1979). However, the dependence between v and π makes this a more complicated problem.

In order to achieve identification I will employ a copula, which allows the representation of the joint distribution, $H(\pi, v|z)$, as a function of the two marginal distributions and a dependence parameter. I can rewrite $H(\pi, v|z)$ as $C(H_\Pi, H_V|z)$, where C represents the dependence structure between the two marginals, H_Π and H_V. Then, the distribution of welfare is just the convolution of the marginal distributions of profits and valuations:

$$\begin{aligned} H_V(t|z) &= \Pr(v < t|z) = \Pr(w - \pi < t|z) \\ &= \Pr(w < t + \pi|z) \\ &= \int F(t+\pi|z)h(\pi|t,z)d\pi, \end{aligned} \tag{9}$$

and I can represent the conditional density of profits, $h(\pi|v)$ using the copula (suppressing the firm characteristics, z, for clarity):

$$h(\pi|v) = \frac{h(v,\pi)}{h_V(v)} = c(H_V, H_\Pi)h_\Pi(\pi). \tag{10}$$

Here I have to make an assumption on the specific parametric copula to employ, and I use the Ali–Mikhail–Haq (AMH) copula, which is from the Archimedian family. The AMH copula has one parameter that governs the dependence structure and allows for that parameter to be negative:

$$c(H_V, H_\Pi) = \frac{1 + \psi[(1+H_V)(1+H_\Pi) - 3] + \psi^2(1-H_v)(1-H_\Pi)}{[1 - \psi(1-H_V)(1-H_\Pi)]^3}, \tag{11}$$

where ψ is the dependence parameter. Another advantage of the AMH copula is that there is a close relationship between the dependence parameter, ψ, and the correlation measures Kendall's τ and Spearman's ρ (Kumar, 2010).[49] Therefore, I can solve for ψ, given the assumption that the correlation between valuations and profits in the runner-up locations (recovered in Section 4.2) is the same as the correlation between valuations and profits throughout the distribution:

Assumption 6 $\rho(v^{runner-up}, \pi^{runner-up}) = \rho(v, \pi)$.

So I can rewrite Equation 9 as:

$$\begin{aligned} H_V(t) &= \int F(t+\pi)h(\pi|t)d\pi \\ &= \int F(t+\pi)c(H_V(t), H_\Pi(\pi))h_\Pi(\pi)d\pi \end{aligned} \tag{12}$$

and I have only one unknown to solve for, the marginal distribution of valuations: $H_V(t)$.

[49] Kendall's $\tau = \frac{3\psi-2}{3\psi} - \frac{2(1-\psi)^2\ln(1-\psi)}{3\psi^2}$ and Spearman's $\rho = \frac{12(1+\psi)di\log(1-\psi) - 24(1-\psi)\ln(1-\psi)}{\psi^2} - \frac{3(\psi+12)}{\psi}$, see Kumar (2010) for derivation.

5 Estimation and Results

The estimation argument closely follows the identification argument. I follow the steps below:

Step 1 Estimate Equation 6 via linear regression.

Step 2 Predict runner-up profits and valuations, given estimates from Step 1.

Step 3 Calculate welfare in the runner-up location, given profit and valuation from Step 2.

Step 4 Use the order statistic identity to recover the distribution of welfare, given the 2^{nd} order statistic of welfare (Step 3).

Step 5 Invert the distribution of welfare (Step 4) to recover the marginal distribution of valuations. I difference out the distribution of profits. This requires information on the profit parameters (Step 1) and the correlation between runner-up profits and valuation (Step 2).

5.1 Step 1: Linear Regression of Subsidies on Location Differences

From Section 4.1, the equation of interest is repeated below:

$$b_{1i} = \beta_i(x_2 - x_1) + \alpha_1 x_2 + \alpha_2 z_i + \alpha_3 x_2 \cdot z_i + \theta_i. \qquad \text{(6 revisited)}$$

where b_{1i} is the winning subsidy offer, z_i are the firm characteristics, x_1 are the characteristics of the winning location and x_2 are the characteristics of the runner-up location. The profit parameters, β_i, represent the interaction of the preference parameter at the mean β, with the firm characteristics z_i. The level of observation for the location characteristics is the state-commuting zone pair. The characteristics that enter the profit function include state tax rates, local industry concentration, local industry wages, local housing prices, state right-to-work status, infrastructure (large airport, road quality), and workforce (population with bachelors degree, local research university). The location characteristics included are described in detail in Appendix D and Table D.1.

I allow the industry of the firm, jobs promised, and investment planned to enter the profit function in $\beta_i = \beta \times z_i$. I also estimate Equation 6 separately for manufacturing and service industry firms. Manufacturing plants and services establishments likely have very different profit functions. The goal is to allow for as much heterogeneity in the profit function, given the relatively small sample size.

Table 3 displays the estimates of the parameters of the profit function, $\hat{\beta}$, from equation 6. The dependent variable is the winning subsidy (in \$ million). The top panel has the estimates for the manufacturing subsample, and the bottom panel has the estimates for the services subsample. The last column in each panel, column (3), displays the specification of interest, which includes all of the potential variables for profit and valuations. This is the specification I will use for the remainder of the estimation process.

The profit parameters are estimated off of the differences between runner-up and winning state and local characteristics.[50] The coefficients, $\hat{\beta}$, can be interpreted as the change in subsidy size needed to win a firm, given a change in the difference in runner-up and winning characteristics. For example, if the winning state increases the corporate tax rate by one percentage point, the state needs to offer an \$11 million larger subsidy to attract a manufacturing firm, all else equal.[51]

If two states are competing for a traditional manufacturing firm (not in the computers or chemical subsector), and one state is right-to-work and the other is not, the non right-to-work state has to offer about a \$95 million larger subsidy, all else equal.[52] If two cities are competing for a research intensive services firm, but one location has a research university and the other does not, the city with the research university can offer a \$84 million smaller subsidy, all else equal.[53]

Table 4 includes the correlates from the runner-up's valuation function. These coefficients should be interpreted as the average for the runner-ups in the sample, and are meant to provide insights into the determinants of a state's willingness-to-pay.[54] As expected, willingness to pay is increasing in the deal characteristics: jobs promised and the investment planned. For manufacturing firms, less wealthy locations are willing to pay more to win a firm, and industries with higher wages garner substantially higher valuations.[55] States with term-limited governors are willing to pay \$44 million

[50] In about 30% of cases I have more than one runner-up location listed in a subsidy deal, and I cannot distinguish which is the true runner-up and which is the third place location. The results are not sensitive to randomly choosing one as the "true" runner-up, or to using them all, but weighting by number of included runner-ups. The results I show in Table 3 do the latter. When I do not know the runner-up county (only the state) I assign the commuting zone (CZ) that has the highest concentration of industry establishments in that state. The results are not sensitive to other choices of CZ within the runner-up state, or using the state average.

[51] If the establishment is in a services industry, the state needs to offer a \$6 million larger subsidy.

[52] Holmes (1998) compares contiguous counties that share a state border, one county is in a right-to-work state and one is not. The manufacturing share of employment is one-third higher in the right-to-work state county than its neighbor in the non-right-to-work state. The average subsidy size for a traditional manufacturing firm is \$230M, therefore this right-to-work effect amounts to 37% of the subsidy.

[53] The average subsidy size for a research intensive services firm is \$140M.

[54] States may have very different considerations when determining their own willingnesss to pay, and I will remain agnostic about the functional form of v when I recover the distribution.

[55] Per-capita income and wages did not affect the valuation of services firms.

Table 3: Profit Parameters

(a) Manufacturing

	(1)		(2)		(3)	
Profit Function:						
Corporate Tax (%)	-11.73	(7.39)	-7.56	(6.83)	-10.66	(8.74)
Jobs Promised (1,000)						
× Industry Concentration (%)	13.32	(56.75)	109.33	(30.78)	78.85	(19.54)
× Industry Wages ($1,000)	1.51	(0.97)	-0.75	(0.72)	-1.51	(0.75)
Housing Prices ($1,000)	0.12	(0.15)	0.10	(0.16)	0.35	(0.15)
× Investment ($ B)	-0.22	(0.03)	-0.20	(0.04)	0.14	(0.10)
Right-to-Work	3.79	(37.39)	33.77	(31.38)		
× Chemicals/Computing					-48.65	(42.13)
× Traditional Manuf.					95.21	(40.45)
Income Tax (%)						
× Wage $<$ $65,000					18.33	(6.52)
× Wage $\geq$ $65,000					-4.00	(17.62)
% Bad Roads					-3.61	(1.53)
% Population with BA						
× High-Tech = 0					-4.31	(2.33)
× High-Tech = 1					2.18	(5.07)
Observations	209		209		209	
R-squared	0.25		0.61		0.78	

(b) Services

	(1)		(2)		(3)	
Profit Function:						
Corporate Tax (%)	-3.40	(1.67)	-3.58	(1.64)	-5.48	(1.92)
Jobs Promised (1,000)						
× Industry Concentration (%)	21.07	(15.74)	12.79	(3.79)	8.68	(4.30)
× Industry Wages ($1,000)	-0.10	(0.10)	-0.09	(0.10)	-0.01	(0.06)
Housing Prices ($1,000)	0.16	(0.08)	0.14	(0.07)	0.07	(0.06)
× Investment ($ B)	0.07	(0.07)	0.02	(0.06)	-0.12	(0.06)
# Research Universities	5.89	(9.96)	0.03	(8.26)		
× Research = 0					5.75	(6.13)
× Research = 1					84.36	(43.77)
Income Tax (%)					4.12	(2.05)
Right-to-Work						
× High-Tech = 0					34.94	(12.71)
× High-Tech = 1					15.57	(16.86)
Large Airport						
× High-Tech = 0					-1.76	(0.90)
× High-Tech = 1					0.10	(0.72)
Observations	178		178		178	
R-squared	0.13		0.36		0.65	

Notes: Table 3 displays the estimates of the parameters of the profit function: $\hat{\beta}$. This is the estimation of equation 6, where the dependent variable is the winning subsidies (in $ million). The top panel has the estimates for the manufacturing subsample, and the bottom panel has the estimates for the services subsample. Descriptive statistics for location characteristics are in Appendix Table D.1. The mean subsidy size for the manufacturing subsamble is $210 million, and the median is $90 million. The mean subsidy size for the services subsample is $77 million and the median is $48 million. Standard errors in parentheses to the right of the estimates.

Table 4: Runner-up Valuations

(a) Manufacturing

	(1)	(2)		(3)	
Runner-up Valuation:					
Jobs Promised (1,000)		191.80	(34.10)	281.33	(25.85)
Industry Multiplier				11.45	(8.73)
Jobs × Multiplier				-12.87	(4.25)
Investment Planned ($ B)				41.55	(12.57)
Corporate Tax (%)				8.70	(8.91)
Income Tax (%)				-15.47	(7.92)
Term-limited Gov.				-43.53	(26.22)
log(Per Capita Income)				-149.01	(80.16)
log(Industry Wage)				232.04	(82.72)
log(Wage) × log(Income)				-34.44	(19.49)
Change in Manuf. Emp					
× Chemicals/Computing				60.40	(42.93)
× Traditional Manuf.				-74.56	(28.71)
Unemployment Rate (%)					
× Promise ≤1000 Jobs				14.91	(7.28)
× Promise 1000+ Jobs				-9.76	(7.05)
Observations	209	209		209	
R-squared	0.25	0.61		0.78	

(b) Services

	(1)	(2)		(3)	
Runner-up Valuation:					
Jobs Promised (1,000)		37.81	(4.43)	16.75	(6.24)
Investment Planned ($ B)				69.23	(12.86)
Corporate Tax (%)				8.34	(2.51)
Income Tax (%)				-5.76	(2.53)
Term-limited Gov.				14.93	(15.84)
Change in Manuf. Emp					
× Warehousing/Transport				-22.21	(14.58)
× Research Services				-1023.01	(432.33)
× Headquarters				-125.57	(41.97)
× Consulting				8.70	(57.30)
× Other Services				26.07	(107.05)
Unemployment Rate (%)					
× Promise ≤1000 Jobs				2.70	(1.81)
× Promise 1000+ Jobs				-0.85	(3.05)
Observations	178	178		178	
R-squared	0.13	0.36		0.65	

Notes: Table 4 displays the correlations between firm and location characteristics and runner-up locatin willingness to pay: $\hat{\alpha}$. This, paired with Table 3 is the estimation of equation 6, where the dependent variable is the winning subsidies (in $ million). The first specification only includes profit parameters, but is shown here to be consistent with Table 3. The top panel has the estimates for the manufacturing subsample, and the bottom panel has the estimates for the services subsample. Descriptive statistics for location characteristics are in Appendix Table D.1. The mean subsidy size for the manufacturing subsamble is $210 million, and the median is $90 million. The mean subsidy size for the services subsample is $77 million and the median is $48 million. Standard errors in parentheses to the right of the estimates.

less for a manufacturing firm than governors running for re-election, all else equal, but no such effect is found for services firms. Locations with declining manufacturing employment are willing to pay more for traditional manufacturing establishments, as well as some services industries: warehouses, research firms, and headquarters. This is consistent with anecdotal evidence of former manufacturing hubs luring new manufacturers with large industrial sites, and with cities that use the loss in manufacturing to push towards a more services and tech oriented economy (Giang, 2019). Lastly, locations with higher unemployment rates are willing to pay more for smaller projects, in terms of jobs promised. These struggling locations may not be able to compete with the blockbuster subsidies that the larger projects attract.

Model Fit: Profits and Valuations

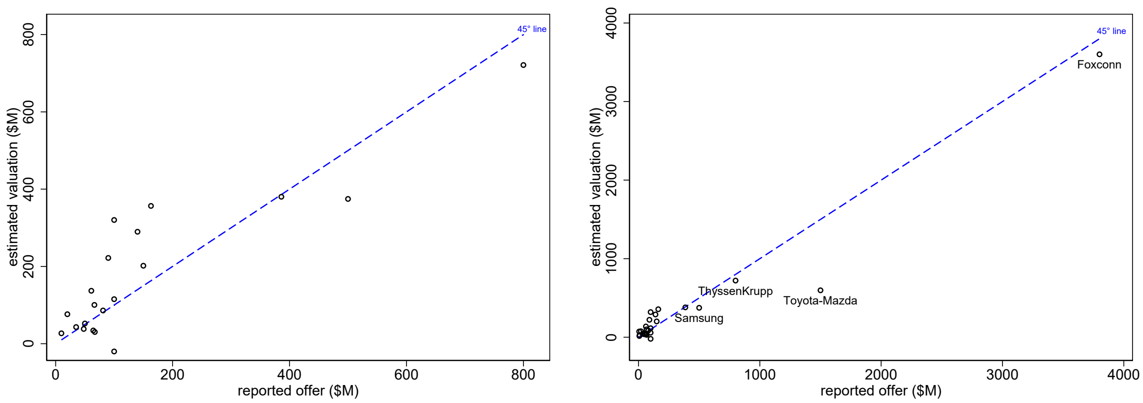
In Section 4 I briefly discuss the implications of the identifying assumptions on the parameters of the firm profit equation (i.e., the scoring rule). In short, I need to assume that the difference in the observed runner-up and winning location characteristics are orthogonal to the unobserved difference in location productivity, and the unobserved runner-up valuation for the firm. The main concern with this assumption is that runner-up states that are less attractive to firms (observable x) may be willing to pay more (unobservable ε). This would introduce a downward bias in the profit parameters, β.

I do not have enough data to estimate a firm-location specific match value, but one possibility would be to estimate establishment profits for a larger sample of firms, outside the model, and use those parameters as the profit parameters. Firm location decisions are very complicated; in reality firms have a network of establishments and relationships across space, and are optimizing with respect to that network. There may be benefits to density (Holmes, 2011) and reducing transportation costs (Houde, Newberry and Seim, 2017); in general there are many potential decision factors that will always be unobserved to the researcher.[56]

Although I do not have external data on profits, I have the reported runner-up subsidy offers in a small subset of subsidy competitions, split between manufacturing and services firms. Figure 6 shows a scatter plot of runner-up subsidy offers (data) and predicted runner-up valuations from estimation

[56]There is much more work to be done to understand the idiosyncratic nature of firm location decisions, and because I am studying a select sample of large, profitable, multinational firms across many industries, the location choices of the average establishment may not reflect the same preferences as the establishments in my sample. Also, if I were to estimate the location decision of establishments and ignore the expected subsidies, I would introduce a different source of bias in the profit parameters.

Figure 6: Model Fit: Runner-up Subsidy Offers and Predicted Valuations



Notes: This is a scatter plot of the reported subsidy offer in the runner-up location, and the estimated valuation of the runner-up location, $\hat{v}_2^{base}$. For exposition, the figure on the left omits 3 outliers with runner-up offers greater than or equal to $1 billion, which are included in the figure on the right. I have data on subsidy offers in the runner-up location in 26 subsidy competitions, 14 of which are manufacturing firms, and 12 are services firms. The correlation coefficient between runner-up subsidy offers and predicted valuations is 0.97 for the full sample, and 0.86 for the sample with runner-up subsidy offers under $1 billion.

($\hat{v}_2^{base}$). The correlation coefficient between runner-up subsidy offers and predicted valuations is 0.97 for the full sample, and 0.86 for the sample with runner-up subsidy offers under $1 billion.

5.2 Step 2: Runner-up Profits and Valuations

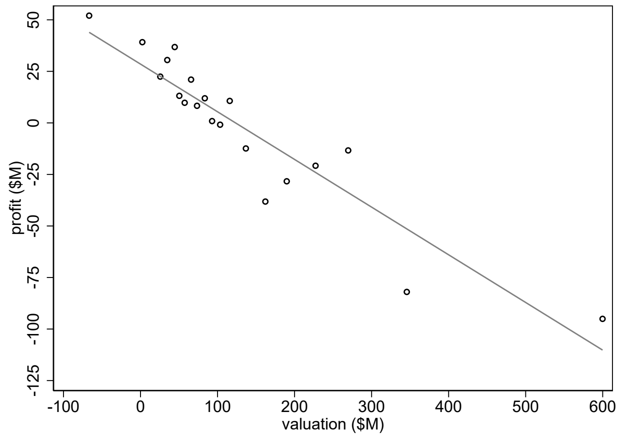
I will use the estimates of $\hat{\beta}$ and $\hat{\alpha}$ (Tables 3, 4), and the residual $\hat{\theta}$, to predict the profits and valuations in the runner-up location. As a reminder, the residual is defined in the structural model: $\theta_i = (\xi_{i2} - \xi_{i1}) + \varepsilon_{2i}$. However, I do not have data to separately identify ξ and ε.

Following the discussion in Section 2.2 on the limitations of the data, measurement error in the subsidy value is a concern. Therefore, one approach to deal with the residual from Step 1 is to attribute it entirely to measurement error, instead of unobservables that are a part of the structural model. I will call this the base, or "no unobservables" case, and define the profits and valuations as follows:

$$\hat{\pi}_{2i}^{base} = \hat{\beta}_i x_2 \tag{13}$$
$$\hat{v}_{2i}^{base} = \hat{\alpha}_1 x_2 + \hat{\alpha}_2 z_i + \hat{\alpha}_3 x_2 \cdot z_i$$

In the second specification, I simulate ξ and ε from a joint normal distribution, with a mean and variance such that the simulated θ (the difference in unobserved profits plus unobserved valuation, $(\tilde{\xi}_{i2} - \tilde{\xi}_{i1}) + \tilde{\varepsilon}_{2i}$) matches the mean and variance of the residual from the estimation of equation 6,

Figure 7: Runner-up $\hat{\pi}$ and $\hat{v}$ (Step 2)



Notes: This figure is the binned scatter plot of predicted profits and valuations in the runner-up location ($\hat{\pi}_{2i}^{base}$ and $\hat{v}_{2i}^{base}$). The profits and valuations are predicted using the estimated parameters from Tables 3 and 4. The correlation coefficient for services is -0.17 and the correlation coefficient for manufacturing is -0.11. Appendix Figure E.1 shows the unbinned scatter plot.

$\hat{\theta}$. The correlation between ξ and ε is given by the observed correlation in $\hat{\pi}_{2i}^{base}$ and $\hat{v}_{2i}^{base}$. The left panel of Figure 7 shows the relationship between $\hat{\pi}_{2i}^{base}$ and $\hat{v}_{2i}^{base}$. The two objects are negatively correlated, suggesting that subsidy competition is likely to strictly increase welfare, as it is more likely to induce firms to choose locations that they wouldn't choose in absence of a subsidy. For manufacturing, the residual is distributed with mean $\mu_\theta = 2.9$ and standard deviation $\sigma_\theta = 266.8$. I have $corr(\hat{\pi}_{2i}^{base}, \hat{v}_{2i}^{base}) = -0.11$ from the predicted runner-up profits and valuations, so I simulate the unobserved productivity and valuation pair from $\binom{\xi}{\varepsilon} \sim N\left(\binom{\mu_\theta}{\mu_\theta}, \sigma_\theta^2 \begin{pmatrix} 1 & -0.11 \\ -0.11 & 1 \end{pmatrix}\right)$.[57]

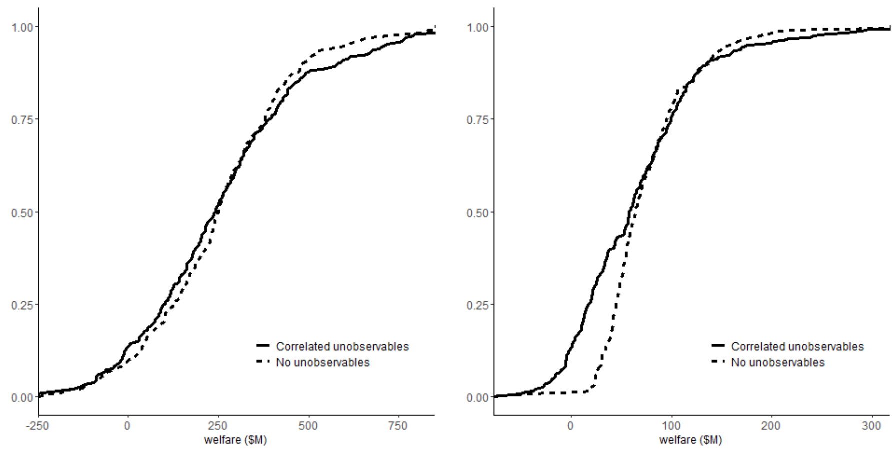
My preferred specification allows for unobservables. It is likely that there are idiosyncratic factors that affect firms profits in a given location, and the valuations for a given firm, that I am not capturing with Tables 3 and 4, as discussed in Step 1 (Section 5.1).

5.3 Steps 3 and 4: Distribution of Welfare

The next step is to calculate welfare in the runner-up location. As a reminder, welfare in this context is defined as the sum of the firm profit and the state and local government's valuation for the firm. Therefore, given the predicted profits and valuations from Step 2, I have the predicted runner-up

[57] For services, the residual is distributed with mean $\mu_\theta = -1.4$ and standard deviation $\sigma_\theta = 67.7$. I have $corr(\hat{\pi}_{2i}^{base}, \hat{v}_{2i}^{base}) = -0.17$ from the predicted runner-up profits and valuations in services, so I simulate the unobserved productivity and valuation pair from $\binom{\xi}{\varepsilon} \sim N\left(\binom{\mu_\theta}{\mu_\theta}, \sigma_\theta^2 \begin{pmatrix} 1 & -0.17 \\ -0.17 & 1 \end{pmatrix}\right)$

Figure 8: Total Welfare in the Runner-Up Location (Step 3)



(a) Manufacturing (b) Services

Notes: The figure shows the empirical distribution of welfare in the runner-up location. The left panel is the manufacturing subsample, and the right panel is services (note the different x-axis range). Welfare is calculated in two ways: with no unobservables, and with jointly normal unobservables, ξ and ε, that fit the distribution of the residual. The correlation between ξ and ε matches that in the baseline predicted runner-up profits and valuations: $\hat{\pi}_{2i}^{base}$ and $\hat{v}_{2i}^{base}$, as described in Step 2 and Figure 7. Appendix Figure E.2 shows the densities.

welfare. The empirical distribution of runner-up welfare is shown in Figure 8. The dashed line is the "no unobservables" case, and the solid line simulates unobservables ξ and ε from a joint normal distribution, as described in the previous section.

Given the empirical distribution of welfare in the runner-up location, I apply the order statistic identity (Equation 8), to recover the full distribution of welfare across competing locations. The number of bidders varies across auctions (see Appendix Figure A.6), so I estimate Equation 8 separately for each number of bidders.[58]

5.4 Step 5: Welfare Inversion

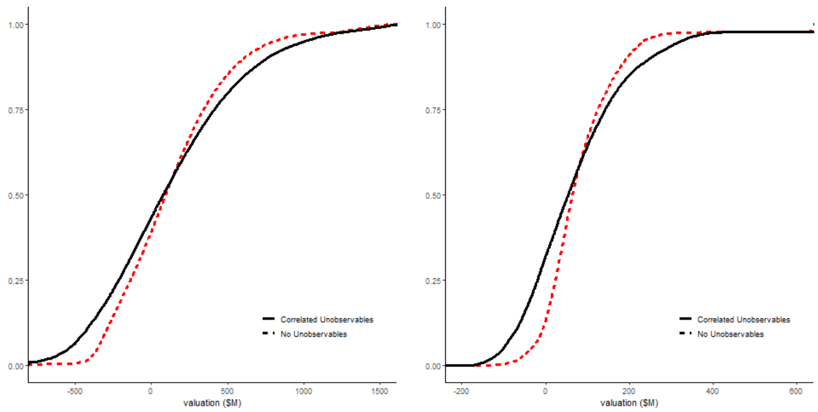
The last step is to recover the marginal distribution of valuations, $H_V(v|z)$.

Given the estimates of $\hat{\beta}$ from Step 1, and ξ from Step 2, I can use the out-of-sample (non winner or runner-up) location characteristics, x, to predict firm profits across competing locations: $\hat{\pi}_{is} = \hat{\beta} z_i x_s + \xi_{is}$, giving way to an empirical marginal distribution for profits $\hat{H}_{\pi}$.[59] Then, given the

[58] All of the auctions with more than 5 bidders are estimated together, because there are not enough observations for each number of bidder above 5. I assign $n = 11$, which is the average for this subset. The resulting distribution, $\hat{F}(w|z)$, is a mixture, given the distribution of bidders across the sample.

[59] From the institutional details of the site selection process (Section 2.2) we know that the competing locations are already selected on having some base level of profitability for the firm. Of course, I do not know this exact set of locations

Figure 9: State and Local Government Valuations for Firms



Pctile	No Unobs.	Corr.	Indep.
Manufacturing			
25^{th}	-138.6	-215.5	-165.0
50^{th}	92.8	76.6	91.5
75^{th}	340.9	412.4	387.3
90^{th}	604.4	756.5	722.9
Services			
Pctile	No Unobs.	Corr.	Indep.
25^{th}	23.1	-19.5	-2.2
50^{th}	63.9	53.9	61.2
75^{th}	124.7	142.2	140.8
90^{th}	193.0	249.4	246.4

(a) Manufacturing (b) Services (c) Table

Notes: These figures display the marginal distribution of state and local governments' valuation for firms. The y-axis is the cumulative distribution, and the x-axis is the valuation, in \$M. The figure on the left is for manufacturing, and the figure on the right is for services. The dashed line denotes the specification where there is assumed to be no unobserved difference in winning and runner-up location productivity or unobserved portion to runner-up valuation. The solid line and the second column in the table denote the specification where the unobservable valuation and productivity are jointly normal with the same correlation as $\hat{v}_2^{base}$ and $\hat{\pi}_2^{base}$. The table on the right reports moments from the distribution for the case with no unobservables, correlated unobservables, and independent profits and valuations.

empirical distribution $\hat{F}(w|z)$, I have enough information to estimate $H_V(v|z)$.

Following the identification strategy in Section 4.3, H_V can be estimated by simulating draws of π_t from the copula $\hat{C}(\pi|v<t,z)$ and calculating the sample average:

$$H_V^S(t|z) = \frac{1}{S}\sum_{s=1}^{S} \hat{F}(t+\pi_t|z). \tag{14}$$

The procedure follows:

1. For each possible valuation, t, I create a grid of guesses for $H_V(t|z)$: $H_V^g(t|z) \in [0,1]$.
2. For each guess $H_V^g(t|z)$, I draw π_t from $\hat{C}(H_\Pi(\pi|z)|H_V^g(t|z))$, S times.
3. I solve for $H_V^S(t|z)$, given π_t: $H_V^S(t|z) = \frac{1}{S}\sum_{s=1}^{S}\hat{F}(t+\pi_t|z)$.
4. For each t, $\hat{H}_V(t|z)$ is the guess, H_V^g, that minimizes $|H_V^g(t|z) - H_V^S(t|z)|$

Figure 9 shows the figures for the marginal distribution of state valuations, separately for manufacturing and services firms. The accompanying table provides the 25th, 50th, 75th, and 90th percentile valuations. The figures and the table in Figure 9 present the results for the "No Unobs." and

for each competition. I drop the bottom 10% of predicted location profits for each firm.

"Corr." cases separately. Recall that the "no unobservables" case assumes is that there is no unobservable component to runner-up profits or valuations, all of the residual from Step 1 (Section 5.1) can all be attributed to measurement error. This is a very strong assumption, and my preferred specification allows for unobservables in both profits and valuations, ξ and ε respectively, as described in Step 2 (Section 5.2).

In the table I present results for one final specification. In this third specification, labeled "Indep.", I assume that profits and valuations are distributed independently. This ignores the negative correlation that I find between runner-up valuations and profits in Step 2 (Figure 7), but will allow us to understand how much of the counterfactual welfare gain is driven by the negative correlation.[60]

Note that the median bidder has a valuation close to the observed subsidy winner in the data. Winning subsidies in the data have a median of \$90 and \$44 million for manufacturing and services, respectively.

5.5 Model Fit

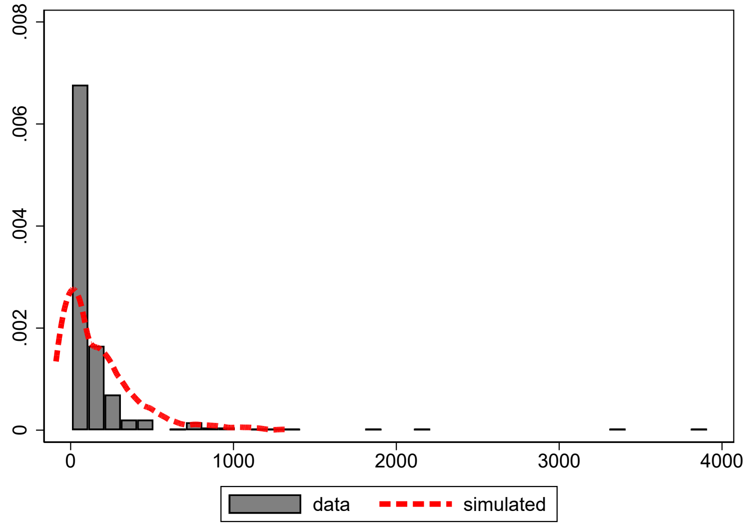
Given these distributions, I can proceed to the counterfactual policy analysis. However, before simulating a counterfactual subsidy ban, I will simulate the subsidy competition game to assess how well the model fits the data.

Figure 5.5 shows the model fit. The histogram represents the observed subsidies (data), and the dashed red line shows the kernel density of the simulated subsidies. These simulated subsidies are the result of simulating profits and valuations for each firm in the data. The simulated subsidy game is played 300 times, and the resulting subsidy is the difference between the profit in the winning location and the profit and valuation in the second highest payoff location. The model is unable to predict the largest subsidies in the data, but there is more mass in the \$100-\$500M subsidy range. I do not restrict subsidies at all in the simulation, therefore the predicted subsidies extend below the artificial cut off of \$5M subsidy size imposed by the sample selection in the data. The mean subsidy in the data is \$149.5M and the mean in the simulation is \$168.9M.

Appendix Table E.1 shows the fit with respect to the identity of the winning state. To the extent

[60] The independent case also allows for unobservables, but the unobservables are also uncorrelated. Following the specification of unobservables in Section 5.2, for manufacturing, the residual is distributed with mean $\mu_\theta = 2.9$ and standard deviation $\sigma_\theta = 266.8$. I now assume $corr(\pi, v) = 0$, so I simulate the unobserved productivity and valuation pair from $\binom{\xi}{\varepsilon} \sim N\left(\binom{\mu_\theta}{\mu_\theta}, \sigma_\theta^2 \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}\right)$.

Figure 10: Model Fit: Simulated Subsidy Competitions



Winning Subsidy ($M)

Pctile	Data	Simulated
25^{th}	27.1	-2.4
50^{th}	59.5	108.7
75^{th}	127.9	264.6
90^{th}	451.9	461.4
Mean	149.5	168.9

Notes: The figure on the left and table on the right show the distribution of subsidies in the data, and the size of subsidies predicted by the model. These simulated wins are the result of playing the subsidy game by simulating profits and valuations for each firm in the data. The simulated subsidy game is played 300 times, and the resulting subsidy is the difference between the profit in the winning location and the profit + valuation in the second highest payoff location. Appendix Table E.1 shows the fit with respect to the identity of the winning state.

that winning locations in the data can differ from the winning locations predicted by the simulations, I will correct for this misspecification when predicting location choices in the counterfactual simulation.[61] For example, Table E.1 shows that the model predicts that under subsidy competition 9.6% of manufacturing firms in the sample will locate in Texas, but only 5.7% of manufacturing firms locate in Texas in the data. Most of this misspecification, in the case of Texas, is driven by the model predicting that firms that are observed locating in Louisiana in the data should instead be located in Texas. Therefore, in the counterfactual where I ban subsidy spending, I could potentially over-estimate the number of firms that would choose alternative locations in the absence of subsidy competition, which would inflate the welfare gain from competition. I will detail the correction procedure in the next section, when I explain the details of the counterfactual.

6 Counterfactual Subsidy Regime

In the early 1990s, United Airlines was holding a bidding war for the location of a new maintenance facility. United set up their negotiations at a hotel, where representatives from the airline would

[61] Thank you to an anonymous referee for this suggestion.

meet up with representatives from cities and states. Jim Edgar, the governor of Illinois at the time, called for a truce with the other states. "If you've got some states doing it, it's hard for the others not to do it. It's like unilaterally disarming," Edgar recalls (Story, 2012). Ultimately, not all states would join in the truce, and subsidy competition for individual firms continues to be part of the economic development landscape. However, a subsidy "truce" between localities, or a federal ban on discretionary subsidy giving, remains a topic of discussion for legislators and concerned citizens.

In fact, the European Union restricts member countries from offering "state aid" to companies (European Commission, 2008). In the U.S., legal scholars have posited that discretionary subsidies are in violation of the commerce clause of the Constitution (Enrich, 1996).[62] In the summer of 2019 the governors of Kansas and Missouri signed a truce to stop offering discretionary tax breaks to attract firms from the other side of the border in the Kansas City metro area (Hardy, 2019). Meanwhile, lawmakers in New York State have introduced the "End Corporate Welfare Act" bill, and are encouraging other states to do the same (Farmer, 2019).

6.1 Implementation

In this counterfactual exercise I eliminate incentive spending and predict where firms would locate in the absence of subsidies. Eliminating incentive spending means that the large firms would have to pay the state's posted corporate tax rate, and receive no tax credits or non-discretionary incentives. This is the most severe potential policy change, which will illustrate the upper bound on the effect of limiting incentive spending. Also, this is a partial equilibrium analysis. States who lose firms when they are not able to compete with discretionary subsidies or tax credits would likely adjust by changing their corporate tax rate or investing in other location characteristics.

There are over 500 localities at this unit of observation, but we know the firms are not considering every location in the United States—in fact there are only a handful of locations under consideration for most firms.[63] Therefore, in order to run this analysis I need to make an assumption on the set of locations the firm will consider.[64] Of course, I do not explicitly model entry, but I can use characteristics of locations that enter the firm's profit function to select the set of locations. I drop

[62] In fact, a 2004 case brought against DaimlerChrysler and the state of Ohio, for an investment tax credit given to the car manufacturer, used this argument. The U.S. Court of Appeals in Cincinnati found the credit unconstitutional, but the ruling was struck down by the Supreme Court for a procedural flaw (Holder, 2018).

[63] See Appendix Figure A.6 for the distribution of reported locations firms consider in each competition.

[64] In some cases, when the number of bidders is small, I know all of the locations in the consideration set.

the locations that are predicted to give the lowest firm profits, as predicted by the profit parameters, $\hat{\beta}$, and those that have the lowest concentration of firms in that industry.[65] Then, for each iteration of the simulation, I randomly select locations to compete for the firm. The number of locations in competition for each firm in the simulation is set to equal the number of bidders from the data. By default, the runner-up location listed in the data is included in the consideration set.

Given this set of competitors, the counterfactual location is simply the location that gives the firm the highest profit. I calculate firm profits in each state-commuting zone, using $\hat{\beta}$ from Table 3, and simulating the firm-location productivity match, ξ.[66] As discussed in Section 5.5, I also adjust for the fact that even with subsidy competition, the model does not always predict that the firm will locate where it is observed locating in the data. To give a concrete example, take the case of Valero Refining. In 2013, Valero received a \$247M subsidy to construct a methanol plant in St. Charles Parish, Louisiana. When I simulate the subsidy game, the model predicts that Valero will locate in Louisiana 59% of the time, and will locate in Texas 30% of the time. When I ban subsidies, the model predicts that Valero will locate in Texas 92% of the time. The misspecification correction adjusts for the probability that the model predicts Valero would have chosen Texas even with subsidies, and attributes 30% of those subsidy ban wins to misspecification, arriving at the result that Valero will locate in Texas in 64% of simulations of the subsidy ban regime.

6.2 Location Results

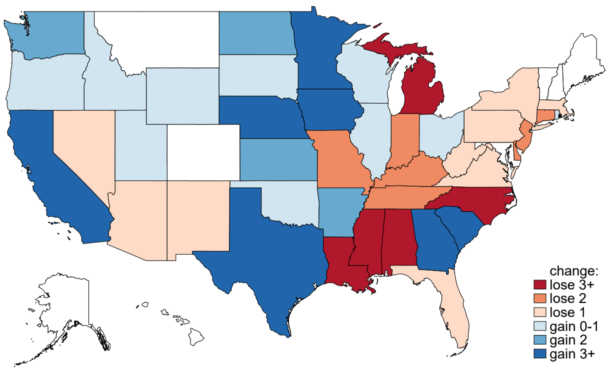
In the counterfactual about 50% of firms choose alternative locations, and 25% of firms relocate to the runner-up location in the competition. When there is no unobserved productivity match 45% of firms stay in the winning location, and about 30% move to the runner-up location.

Figure 11 shows the distributional results of this exercise. The shading represents the change in the number of firms that locate in each state. Panel (a) predicts the results for the manufacturing firms, while panel (b) shows the results for the services firms. In manufacturing, states in the deep south and Midwest are the most likely to lose firms they attract with subsidies, while states like Texas and South Carolina are net gainers. This pattern of middle America losing the most firms in

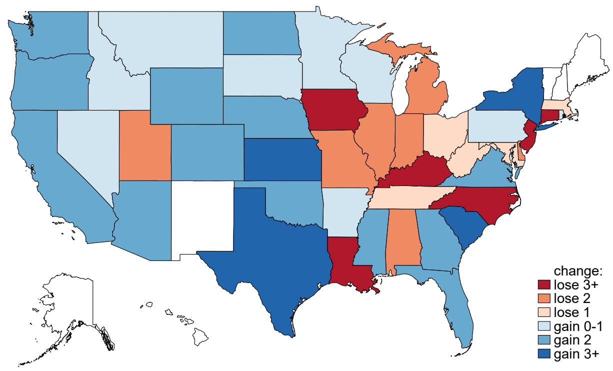
[65] I drop the bottom 10% for both.

[66] This is for the specification which I allow for unobservable productivity. I simulate productivity matches and the set of competing locations 300 times, so for each firm in the sample there can be a distribution of possible counterfactual locations. In the specification where all of the residual heterogeneity in bids is attributed to measurement error, the profits are deterministic, but I still simulate the set of competing locations.

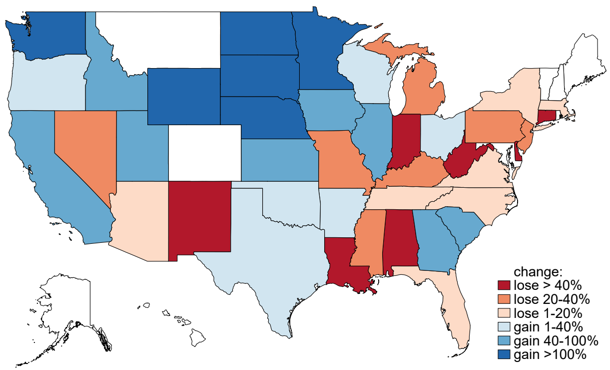
Figure 11: Counterfactual Changes in Firm Locations



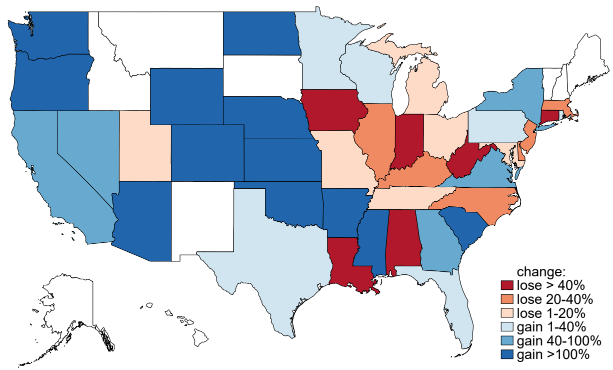
(a) Manufacturing: Change in Number of Firms



(b) Services: Change in Number of Firms



(c) Manufacturing: Percent Change



(d) Services: Percent Change

Notes: In order to determine the counterfactual location I calculate firm profit in each state, using $\hat{\beta}$ from Table 3, and simulating the firm-location productivity match, ξ. I simulate the counterfactual location decision 300 times. The counterfactual location is simply the state that gives the firm the highest profit, given that subsidies are set to 0. This figure shows the distributional results of the counterfactual. The shading in panels (a) and (b) represents the change in the number of firms that locate in each state. The shading in panels (c) and (d) represents the percent change in the number of firms that locate in each state.

the absence of subsidies matches a similar pattern found by Austin, Glaeser and Summers (2018), where the non-employment rate has risen more from Louisiana up to Michigan than in most of the rest of the country.

In services, Texas, California, New York and Virginia, which already offer subsidies in competition, win even more firms in the subsidy ban. Given these findings, it is perhaps unsurprising that New York is one of the states pushing for a ban on subsidy competition. Meanwhile, Alabama won 12 subsidy competitions for manufacturing firms in the last 15 years, and would have won at most 4 of them in the counterfactual. These results suggest that any type of subsidy "truce" would likely be hard to sustain—there are clear winners and losers across states in the subsidy ban.

Table 5: Welfare Analysis

	Jointly distributed π and v						**Independent π and v**		
	No Unobservables			Correlated Unobservables			Independent Unobservables		
\$B	Ban	Comp.	Δ	Ban	Comp.	Δ	Ban	Comp.	Δ
Valuation (v)	64.0	82.4		65.1	87.4		66.2	83.1	
Profits (π)	31.4	22.3		32.5	20.8		31.7	20.8	
Subsidy	0.0	57.9		0.0	57.9		0.0	57.9	
Total Welfare	95.4	104.7	9.7%	97.6	108.3	10.9%	97.9	103.9	6.1%
State Payoff	64.0	24.5	-61.7%	65.1	29.5	-54.6%	66.2	25.2	-61.9%
Firms Payoff	31.4	80.2	155.3%	32.5	78.7	142.2%	31.7	78.7	148.3%

Notes: Table 5 displays the results of the counterfactual welfare analysis. The columns in the table corresponds to a policy (competition or subsidy ban) and a model specification (correlation, independent). For the "competition" policy, locations are observed, and I simulate the valuations of the winning locations from $\hat{H}_V(v|\pi,z)$. For the "subsidy ban" policy, locations are predicted, as depicted and described in Figure 11. The first row shows the sum of the simulated valuations. The second row shows the sum of simulated profits. Under either policy, state payoffs are equal to the total valuations less the total subsidy spending (which is equal to 0 if there is a ban). The firm payoffs are equal to the total profits plus the total subsidy spending. The welfare gain is the difference in percent change in total welfare between competition and the subsidy ban.

6.3 Welfare Results

Given the observed and counterfactual locations, and the simulated profits, I simulate the valuation in each location from $\hat{H}_V(v|\pi,z)$.[67] Table 5 displays the results from this exercise. Each column in the table corresponds to a policy (subsidy competition or subsidy ban) and a model specification. The total amount spent on discretionary subsidies in my sample (2002-2017) is about \$58 billion. This is the subsidy spending under competition, the current policy. Under a subsidy ban, subsidy spending would be \$0, mechanically.

The first row of Table 5 shows the total valuations for winning locations under the ban (the simulated valuations in locations chosen when I shut down subsidy spending) in column 1, and subsidy competition (the simulated valuations in locations we observe firms locating, with subsidies) in column 2. This is repeated for different assumptions on the distribution of profits and valuations, and the structure of the unobservables. The second row lists the sum of total predicted profits for winning locations under the subsidy ban and subsidy competition.[68]

The allocative efficiency argument for subsidy-giving is evident in this simulation — when there are no subsidies firms locate in higher profit locations, which can have lower valuations for winning

[67] I can link the marginal distributions $\hat{H}_\Pi$ and $\hat{H}_V$ via copula, where the dependence structure relies on the estimated correlation between runner-up valuations and profits, as detailed in Section 4.2.

[68] See Appendix Table E.3 for the same table broken out separately for Manufacturing and Services.

the firms. With competition, the simulated valuations are substantially higher — the higher valuation locations now can express that valuation in the form of a subsidy. However, these higher valuation places can also have lower profits.

The welfare gain with independently distributed profits and valuations is about 5 percentage points smaller than under the baseline with negative correlation, at 6.1% instead of 10.9%. The difference between valuations and profits in the subsidy ban and subsidy competition highlights the different dependence structure: when profits and valuations are jointly simulated with a negative correlation, the difference between valuations under competition and valuations under the subsidy ban is \$22.3B. When the profits and valuations are simulated independently the difference between valuations under competition and valuations under the subsidy ban is 25% smaller, at \$16.9B. As shown with the model simulations in Appendix Section C, the heterogeneity in valuations also contributes to welfare. The "No unobservables" distribution of valuations has a lower variance than the specification with correlated unobservables, which contributes to a lower welfare gain.

I can also use the simulated valuations and profits to calculate the payoffs for each agent. The payoffs for the states is the total valuation, v, in winning states, less the subsidy payment. The payoffs for the firms is the total profits, π, in the chosen location, plus the subsidy payment. It is clear that the firms are the winners of subsidy competition: in each specification firm payoffs more than double under subsidy competition, while state payoffs decrease substantially. In fact, total state payoffs are about \$40 billion lower under subsidy competition than under the subsidy ban. This result is due to the degree of heterogeneity in $\hat{H}_V(v|z)$. If the valuations were even more heterogeneous, it would not be the case that most of the surplus is competed away.

A potential concern is that these results are driven by the specific parameterization of profits and valuations I specified in Section 5.1. Therefore, in the Appendix I repeat the estimation process and counterfactual simulations for an alternative specification.[69] The baseline specification, used throughout Section 5 and in the counterfactual results to this point, is specification 3 from Tables 3 and 4. The alternative specification, also in Tables 3 and 4, is specification 2. This alternative specification allows for less industry and firm specific heterogeneity in the profit function, and specifies runner-up valuation as a linear function of promised jobs. The distribution of the valuations for the alternative specification is shown in Table E.2, and the counterfactual welfare analysis is shown in Table E.3. The analysis with the alternative specification gives way to qualitatively similar results:

[69] Thank you to an anonymous referee for this suggestion.

the welfare gain is 13.0% when profits and valuations are jointly distributed and 7.8% when they are independent, as opposed to 10.9% and 6.1% in our baseline specification.[70]

6.4 Alternative Definitions of Welfare

Two considerations may dampen the estimated welfare gain from subsidy competition. First, Table 4 shows that states with governors facing re-election are willing to pay substantially more for a manufacturing firm, all else equal. In fact, the valuation for governors facing re-election is \$44M (20%) higher than their term limited counterparts. This raises the issue that the "welfare" of the state decision maker may not align with that of a social planner. In Appendix Table E.4 I re-estimate state and local valuations for manufacturing firms under the assumption that there is no re-election benefit to winning a firm. In other words, I treat all states as if they have term-limited governors. At the mean, valuations are about 10% smaller when the re-election effect is eliminated. At the median, valuations are about 40% smaller than the baseline. Of course, the object of interest is welfare, so I take this exercise to the simulations. If all of the states that win firms in the data were treated as term-limited, the total state payoffs resulting from competitions for manufacturing firms would decrease by \$4.8B, from \$26.8B to \$22.0B.[71]

In a related issue, states may not be able to accurately predict the benefit a firm will have in their jurisdiction. If governors are present-biased, they may put more weight on the short-term benefits of winning a firm, and discount the future costs. Or, it may be that all states are over-optimistic about the benefit of winning any particular firm, because they are using inflated multipliers that lead to high spillover predictions. In a back of the envelope exercise, I find that if states slightly overestimate their valuation of a firm, the welfare gain from subsidy competition quickly dissipates. The results are shown in Table E.3, where I simulate the valuation for firm i (v_{is}) for winning locations s from $\hat{H}_V(v|\pi,z)$, but assume that all states are optimistic, and the true valuations is v^*, where $v_{is} = (1+oo)v^*_{is}$. In this exercise, I find that if states are 10% over-optimistic about the value a firm

[70] The welfare gain for manufacturing firms is higher in the alternative specification than the baseline, but lower for services firms. There are two forces at play here. First, the correlation between runner-up profits and valuations for manufacturing firms is -0.18 under the alternative specification, and -0.11 under the baseline. For services firms it is positive in the alternative specification, 0.31, and negative in the baseline, -0.17. This would predict that welfare should increase for manufacturing and decrease for services, relative to the baseline. However, the variance of valuations is larger in the alternative specification for services, which would contribute to a welfare gain. Empirically, we see that the welfare gain increases for manufacturing but decreases for services. The welfare split between states and firms is also qualitatively similar to the baseline. See Appendix Table E.3 for more.

[71] I investigate the extent of politicization in subsidy-giving further in Slattery (2020). Draft available upon request.

will create, almost 20% of winning states would be subject to the winners curse, and would have offered a subsidy greater than the realized valuation.

7 Discussion

I chose the private value English auction to model state competition for firms. More specifically, it is a private value English scoring auction, with an unobserved to the econometrician scoring rule. I use the English auction because I have evidence from state documents on subsidy-giving that there are multiple rounds of bidding and that states know each others' subsidy offers. In this section I discuss the implications of some of the assumptions of the model.

Budget Constraints

The model does not capture every feature of the incentive competition landscape. One simplification is with respect to the state economic development budgets. In reality the state may be budget constrained. However, discussions with employees at various state economic development agencies made it clear that the "budget" is a very ill-defined concept, and large discretionary subsidy deals are often made under the assumption that the state will "find" or budget the money in the future. This is fairly easy for most states to do because the structure of discretionary subsidies is such that most of the subsidy size is foregone revenue. In other words, the state has a contract with the firm that they will not collect taxes (or collect at a lower rate) for a certain amount of time. For a longer discussion of this assumption and the determination of economic development budgets see Appendix A.

One remaining concern about the budget is that smaller states, with already low corporate taxes, will not be able to put together a large enough subsidy to win a firm. I never observe Vermont, New Hampshire, Maine, Wyoming, Montana, North Dakota, or South Dakota winning a subsidy competition in my sample.[72] Does that mean that these states do not have high valuations for firms? These states may be less profitable locations, so they may not even be in the consideration set of the firm, or when they are in the competition they simply do not offer the highest payoff, given they bid up to their valuation. Alternatively, it may be that the budget constraint is sometimes a factor. South Dakota has a corporate tax rate of zero and an average property tax of 1.32%. Therefore South Dakota cannot forego revenue in order to attract a firm; it will need to find money in the budget to

[72] I restrict the sample to subsidy deals in the 48 contiguous states, so Alaska and Hawaii are mechanically dropped.

build the subsidy offer. Understanding the role of the budget in low revenue, low tax rate states, and the trade-off between offering low tax rates and targeting individual firms, is a rich area for future work.

Dynamics

In the absence of a budget constraint, states do not have to consider the effect of winning a firm today on the probability of being able to win a firm tomorrow. Relatedly, I assume the state valuations for firms are independently distributed, and thus do not explicitly consider any dynamic interactions in the valuations of firms. For example, the state does not necessarily value a tire manufacturer more or less once they have won a competition for an automobile manufacturer. However, to the extent that winning a firm changes the location characteristics, synergies between firms are in fact encompassed by the model. For example, if winning an automobile manufacturer increases the profitability of the location for the tire manufacturer, the state will be more likely to also win the tire manufacturer. If winning an automobile manufacturer increases employment in the transportation sector, and the match between existing employment and the industry of a firm is something that affects the states' willingness-to-pay, the state may have a higher valuation for the tire manufacturer.

Common vs. Private Values

Another modeling choice is that the auction is private value. One approach would be to model this as a common value, as opposed to a private value auction. In the pure common value auction, the bidders (states) have different information, but identical values for the good (firm). This means that the firm creates the same amount of value (in tax revenue, indirect job creation, etc.), regardless of the location it chooses. This assumption is not supported by most of the literature (Greenstone, Hornbeck and Moretti, 2010; Bartik, 1991).

In reality this is likely an auction with both a private and common value component. This is a fact of most auction settings. However, most empirical auction work is divided into purely private value and purely common value auctions. One reason for this dichotomy is that it is more difficult to identify the primitives of auctions with both private and common value elements. From the work of Goeree and Offerman (2002, 2003) on competitive bidding in auctions with private and common values, it is clear that much more data would be needed to identify both the common value and private value distributions, namely data on the level that each bidder drops out.

Another way to think about the value structure in my context is that $H_V(v)$ is not the distribution of true values, but the distribution of beliefs about the value the firm will create, which is still location-specific. Throughout the analysis I assume the states can accurately predict the benefit a firm will have in their jurisdiction, and I estimate the state valuations using data on realized subsidy deals. I use a revealed preference approach; the subsidy deals offered by the state reveal the states' underlying valuation for the firm. However, it is possible that states overestimate the effect a firm will have once it locates in the state. If state and local governments overestimate the true benefit, the winning location can suffer from the winner's curse, as discussed in Section 6.4.

Whether states can accurately predict the revenue and job creation effects of a potential entrant is an open question, because the analysis of the economic effects of firms post-subsidy disbursement is limited. Estimated valuations are much larger for firms in industries with high predicted job multipliers, but evidence on the actual spillovers realized is mixed (Slattery and Zidar, 2020; Greenstone, Hornbeck and Moretti, 2010; Patrick, 2016). A recent push for transparency might soon provide the data to study whether (and when) the realized benefit aligns with the ex-ante valuations.[73]

8 Conclusion

States and local governments offer generous tax credits and subsidy deals to attract individual firms to their jurisdiction. The extent to which these incentives improve allocative efficiency depends on the firm's profitability in the locality and the locality's valuation of the firm. Therefore, in order to understand the welfare effects of subsidy competition one must know both (1) how state and local governments determine discretionary subsidies, and (2) the effect of subsidies on firms' location choice. Due to the lack of transparency of the subsidy setting process, the lack of data on realized subsidy deals, and the equilibrium nature of the observed outcome, these two questions have historically been difficult to answer.

To make progress on this line of inquiry, I introduce a new data set on discretionary subsidies, which I create by reading state budget documents and tax expenditure reports, as well as press releases and news articles on each subsidy deal. Then, I use an open outcry ascending auction to model the bidding process. To capture the fact that, all else equal, a less "attractive" location must offer a

[73] As of 2015, the Government Accounting Standards Board requires that state and local governments disclose all tax abatements to firms (Governmental Accounting Standards Board, 2015). Relatedly, the National Conference of State Legislatures has noted an increase in state-level incentive programs evaluations published post-2014.

larger subsidy to attract a firm, I embed the location choice problem of the firm within the auction framework. I allow a local government's valuation for a firm to depend on firm and location characteristics, such as the number of direct jobs promised by the firm and the characteristics of the local economy.

I find that competition increases welfare by about 10% over a counterfactual subsidy ban, but this surplus is captured entirely by the firms. In the aggregate, states are better off in the subsidy ban, but my results suggest that any type of subsidy "truce" would likely be hard to sustain—there are clear winners and losers across geographies. I also find that politics affect governments' willingness-to-pay, which limits the scope for allocative efficiency gains. Understanding why the "re-election" effect is so large, and whether it affects the distribution of resources within a state, is an important area for future work (Jensen and Malesky, 2018).

There is still much to learn about discretionary subsidy-giving and its role in state and local economic development policy. Future work should consider the trade-offs between spending on discretionary subsidies for a few large firms and more broad-based incentive programs. There are opportunity costs to states spending on incentives for a few large firms; they could instead lower taxes for citizens, invest in public goods, or create incentive programs for small businesses. Also, giving discretionary tax breaks to a few large firms may have anti-competitive effects on the product market, as these firms now have lower costs then their competitors.[74] We also need to more about distributional impact once the establishment opens—who is hired and what happens to local prices? The poorest places, with the highest unemployment rates and potentially the highest values for jobs, are never observed winning a subsidy deal (Slattery and Zidar, 2020).

In short, this paper identifies an important force we should use to think about discretionary subsidy-giving, which is a popular economic development tool in the United States and worldwide. The model allows us to learn about state and local governments' willingness to pay for a firm with limited data. Although there is scope for subsidy competition to increase the allocative efficiency of firm locations, the influence on politics on government valuations of firms, and the difficulty in forecasting the effect of any individual establishment, greatly limit the potential gains. Understanding the disconnect between state government valuations and the actual benefit a firm creates for constituents is crucial to evaluating the welfare implications of subsidy-giving. The data introduced in this paper

[74] Rossi-Hansberg, Sarte and Trachter (2018) find that although national product market concentration is increasing, when the top firm in an industry opens a plant, local concentration declines. The effect of discretionary subsidies on product-market competition, both at the local and national level, as yet to be studied.

can be used to push research in this arena further.

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Appendix

A Institutional Details: State Economic Development and Data

State Budget Process

The budget process of the state generally follows these steps:[75]

1. Each department and agency of the state government prepares a budget request and submits it to the governor. This process begins at least one year before the budget year, when the governor sends instructions on what level of resources the department should plan for.

2. The governor receives the agency budget proposals in the Fall, and prepares the final budget proposal, submitting it to the state legislature by late January/early February.

3. The budget is received by the appropriations committee in the House and then sent to the Senate. If the budget approved by the state Senate differs from that approved by the house the two groups must work out a compromise in conference committee.

4. The budget is sent back to the governor, who signs it, vetoes the entire bill, or vetoes certain line items.

Differences in state budget processes lie in the governors ability to line-item veto, biennial or annual budget setting, the rigidity of the balanced budget requirement, and super-majority legislature rules.[76]

Unlike at the federal level, most of the power lies at the governor. The governor must submit a budget in balance, which makes it more difficult for the legislature to make changes. The governor also has a full-time staff and generally has more information and time for budget setting than the legislature, especially in states where the legislature is a part-time job and only convenes for a couple of months. Lastly, 43 states give the governor the power to line-item veto items from the budget.

[75] This is written with a July 1-June 30 fiscal year, though four states follow a different schedule.

[76] 19 states have a biennial budget setting process, which means that they set the budget for two years. However only 4 states have biennial meetings, so most states still meet annually, and enact supplemental budgets to amend the biennial budget. For this reason, many argue that setting a biennial budget is wasteful, as the state will need to amend and set supplemental budgets in the "off" year.

State Legislative Process

The budget process determines how much money goes to existing programs. Changing and enacting tax credits and economic development programs requires legislation. States' legislative processes are much more heterogeneous than the budget process. Each state may establish its own rules for procedure, which means that it has its own process for considering and enacting bills. In broad strokes, the bill will be introduced in the House or Senate, or in committee, and then goes through steps of being debated, opened to public opinion, and amended, with votes at various parts of the process, in both chambers of the state legislature. In the last step it goes to the governor, who has veto power. 46 state legislatures meet annually, so those states may enact new legislation each year.

States can also call special, or extraordinary sessions, in order to address unfinished business or special topics, such as emergencies and natural disasters. Governors sometimes call special sessions in order to approve incentive packages for discretionary subsidy deals.

Data Collection: State-level spending

There are two primary ways a state can create financial incentives for businesses. The first is to offer a tax credit, or to lower the tax rate, which lowers the tax bill of the business. States track the amount spent (revenue foregone) on each credit program in their Tax Expenditure Reports. The second way to provide for incentives is to allocate money for economic development programs in the state budget (e.g. grant, discretionary fund, infrastructure project). States track the amount allocated and spent on each program in their annual (or biennial) budget documents.

In order to create my dataset I download each tax expenditure report and budget document from state websites for the years 2006-2016. If those items are not available I contact the state Department of Revenue and/or Budget Office. The tax expenditure reports and budget documents vary widely in formatting, not only across states but over time. New economic development programs and tax credits are introduced over the sample period, names often change, and programs can be reorganized between departments. This makes any machine learning technique extremely difficult, so I read each document to identify tax credits and budget items targeted at businesses, and collect the data by hand.

The amount foregone in tax revenue due to tax credits is recorded in the states' tax expenditure reports. Figure A.1 provides two examples of tax expenditure reports, from Virginia and North Carolina. In Virginia's document, each credit is listed, along with the number of returns filed that take the credit, and the total amount that was claimed on those returns. In North Carolina, the state reports the description of each credit along with an estimate of the amount that will be claimed in each fiscal year.

Figure A.2 provides an example of budget documents in both states (Virginia and North Carolina). Virginia has a website for their budget, which allows you to search for keywords, e.g. "economic development." However, the line items are not very specific, as evidenced in the figure. The footnote provides more information, detailing that these "Economic Development Services" are used at the discretion of the Governor to attract economic development prospects to locate or expand in Virginia. North Carolina's budget has very specific line items, and the amount spent and authorized each year. Another section of the document provides descriptions of each of the line item programs.

I record each program and credit in a state level dataset that covers the years 2007-2014. Based on the text description of the program (if any) I can classify the spending by stated purpose or target: Business Attraction, Jobs, Job Training, Investment, Manufacturing, R&D, High-Tech, and Small Business. In the state-program level data I note that funds are often earmarked for discretionary spending, e.g. "Strategic Attraction," and when states do break out tax credit expenditures by firm, the majority of spending goes to a few firms. Firms receive different tax treatments within one state, thus one needs firm-level data to understand state incentive spending policies.

In Section 2.2 I also mention anecdotal evidence that states consider *indirect* job creation when determining their subsidy offers. Figure A.3 provides such an example. This is an excerpt from a report on North Carolina's discretionary grant program. North Carolina is one of the few states to publish spending at the firm level. The 4th column in the table lists the number of expected (direct) jobs the firm will create, while the 5th column is the number of indirect and induced jobs. In this paper, these are the "spillover" jobs the state might care about, and it is proxied with the industry multiplier. The table also suggests that the state cares about the firm's effect on GDP and state revenue (columns 7 and 8).

Figure A.1: Example of Tax Expenditure Reports

Table 3.1
Fiscal Year Tax Credits
Returns Processed During Fiscal Year 2015

Code Section(s)	Credit	Year Enacted	Credit Claimed Against	Number of Returns	Amount
§§ 58.1-439.18 et seq.	Neighborhood Assistance Act Credit	1981 (effective July 1, 1981)	Individual, Corporate, Insurance and Bank	4,393	$14,512,830
§ 59.1-280	Enterprise Zone Business Tax Credit	1982 (effective July 1, 1982)	Individual, Corporate, Insurance and Bank	12	1,218,516
§§ 58.1-334 & 58.1-432	Conservation Tillage Equipment Credit	1985 (effective 1985)	Individual and Corporate	255	486,727
§ 58.1-435	Low-Income Housing Credit	1989 (effective 1990)	Individual, Corporate, Insurance and Bank	*	15,542
§§ 58.1-337 & 58.1-436	Advanced Technology Pesticide and Fertilizer Application Equipment Credit	1990 (effective 1990)	Individual and Corporate	99	156,193
§ 58.1-438.1	Tax Credit for Vehicle Emissions Testing Equipment and Clean-Fuel Vehicles and Certain Refueling Property	1993 (effective 1993)	Individual and Corporate	41	9,482
§ 58.1-439	Major Business Facility Job Tax Credit	1994 (effective 1995)	Individual, Corporate, Insurance and Bank	74	4,109,769
§ 58.1-439.2	Coalfield Employment Enhancement Tax Credit (Refundable)	1995 (effective 1996)	Individual and Corporate	49	28,363,515
§ 58.1-439.1	Clean Fuel Vehicle and Advanced Cellulosic Biofuels Job Creation Tax Credit	1995 (effective 1996)	Individual and Corporate	191	307,062
§ 59.1-280.1	Enterprise Zone Real Property Investment Tax Credit (Refundable)	1995 (effective July 1, 1995)	Individual and Corporate	0	0
§ 58.1-339.2	Historic Rehabilitation Tax Credit	1996 (effective 1997)	Individual, Corporate, Insurance and Bank	1,038	97,998,279
§ 58.1-439.4	Day-Care Facility Investment Credit	1996 (effective 1997)	Individual and Corporate	0	0
§§ 58.1-339.3 & 58.1-439.5	Agricultural Best Management Practices Tax Credit	1996 (effective 1998)	Individual and Corporate	471	1,144,933
§ 58.1-439.6	Worker Retraining Tax Credit	1997 (effective 1999)	Individual, Corporate, Insurance and Bank	6	160,926
§ 58.1-439.7	Recyclable Materials Processing Equipment Credit	1998 (effective 1999)	Individual and Corporate	91	623,285
§ 58.1-332.1	Foreign Tax Credit	1998 (effective 1998)	Individual Only	1,689	507,562
§ 58.1-339.4	Qualified Equity and Subordinated Debt Investments Tax Credit	1998 (effective 1999)	Individual Only	241	2,096,539
§ 58.1-439.10	Waste Motor Oil Burning Equipment Credit	1998 (effective 1999)	Individual and Corporate	62	124,387
§ 58.1-439.9	Tax Credit for Certain Employers Hiring Recipients of Temporary Assistance to Needy Families (TANF)	1998 (effective 1999)	Individual and Corporate	0	0
§ 58.1-512	Land Preservation Tax Credit	1999 (effective 2000)	Individual and Corporate	3842	67,668,579
§ 58.1-339.6	Political Candidates Contribution Tax Credit	1999 (effective 2000)	Individual Only	17,357	604,377
§ 58.1-339.7	Livable Home Tax Credit	1999 (effective 2000)	Individual and Corporate	284	823,494
§ 58.1-433.1	Virginia Coal Employment and Production Incentive Tax Credit	1999 (effective 2001)	Corporate Only	7	8,909,576
§ 58.1-339.8	Low-Income Taxpayer Credit	2000 (effective 2000)	Individual Only	364,370	133,791,162
§§ 58.1-339.10 & 58.1-439.12	Riparian Forest Buffer Protection for Waterways Tax Credit	2000 (effective 2000)	Individual and Corporate	98	229,754
§ 58.1-339.9	Rent Reductions Tax Credit	2000 (effective 2000)	Individual and Corporate	0	0
§ 58.1-339.11	Long-term Care Insurance Tax Credit	2006 (effective 2006)	Individual Only	4,081	1,174,845
§ 58.1-439.12:02	Biodiesel and Green Diesel Fuels Producers Tax Credit	2008 (effective 2008)	Individual and Corporate	0	0
§ 58.1-439.12:05	Green Job Creation Tax Credit	2010 (effective 2010)	Individual and Corporate	*	752
§ 58.1-439.12:04	Tax Credit for Participating Landlords (Community of Opportunity)	2010 (effective 2010)	Individual and Corporate	20	42,041
§ 58.1-339.12	Farm Wineries and Vineyards Tax Credit	2011 (effective 2011)	Individual and Corporate	63	180,535
§ 58.1-439.12:03	Motion Picture Production Tax Credit (refundable)	2011 (effective 2011)	Individual and Corporate	4	7,176,474
§ 58.1-439.12:06	International Trade Facility Tax Credit	2011 (effective 2011)	Individual and Corporate	13	146,096
§ 58.1-439.12:08	Research and Development Expenses Tax Credit (Refundable)	2011 (effective 2011)	Individual and Corporate	317	4,210,012
§ 58.1-439.12:09	Barge and Rail Usage Tax Credit	2011 (effective 2011)	Individual, Corporate, Insurance and Bank	*	41,700
§ 58.1-439.12:10	Virginia Port Volume Increase Tax Credit	2011 (effective 2011)	Individual and Corporate	34	736,816
§ 58.1-439.12:07	Telework Expenses Tax Credit	2011 (effective 2012)	Individual and Corporate	10	112,843
§ 58.1-439.26	Education Improvement Scholarships Tax Credits	2012 (effective 2013)	Individual, Corporate, Insurance and Bank	347	1,613,525

Research & Development Credits

Research and Development Credits (Article 3F)

1. **Small Business R&D Credit**
Citation: G.S. 105-129.55(a)(1)
Description: A small business thas has qualified North Carolina research expenses for the taxable year is allowed a credit equal to 3.25% of the expenses. A small business is defined as a business whose annual receipts did not exceed $1 million. The amount of credit taken in any tax year cannot exceed 50% of the taxpayer's tax liability after other credits taken. Unused credits can be carried forward 15 years.
Enacting Legislation: S.L. 2004-124 - effective for business activities occurring on or after May 1, 2005
Sunset Date: Expires Jan. 1, 2016

Estimate (in millions): FY15-16........$0.3 FY16-17 .... $0.2

Data Source: Department of Revenue "Economic Incentive Reports"

2. **Low-Tier R&D Credit**
Citation: G.S. 105-129.55(a)(2)
Description: A taxpayer that performs research in a development tier one area is allowed a 3.25% credit for eligible expenses. The amount of credit taken in any tax year cannot exceed 50% of the taxpayer's tax liability after other credits taken. Unused credits can be carried forward 15 years.
Enacting Legislation: S.L. 2004-124 - effective for business activities occurring on or after May 1, 2005
Sunset Date: Expires Jan. 1, 2016

Estimate (in millions): FY15-16........$4.0 FY16-17 .... $2.2

Data Source: Department of Revenue "Economic Incentive Reports"

3. **University Research Credit**
Citation: G.S. 105-129.55(a)(2a)
Description: A taxpayer that has NC university research expenses for the taxable year is allowed a credit equal to 20% of the expenses. The amount of credit taken in any tax year cannot exceed 50% of the taxpayer's tax liability after other credits taken. Unused credits can be carried forward 15 years.
Enacting Legislation: S.L. 2004-124 - effective for business activities occurring on or after May 1, 2005
Sunset Date: Expires Jan. 1, 2016

Estimate (in millions): FY15-16........$0.5 FY16-17 .... $0.3

Data Source: Department of Revenue "Economic Incentive Reports"

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Research & Development Credits

4. **Eco-Industrial Park R&D Credit**
Citation: G.S. 105-129.55(a)(2b)
Description: A taxpayer that performs research in an Eco-Industrial Park certified under G.S. 143B-437.08 is allowed a 35% credit for eligible expenses. The amount of credit taken in any tax year cannot exceed 50% of the taxpayer's tax liability after other credits taken. Unused credits can be carried forward 15 years.
Enacting Legislation: S.L. 2010-147 - effective for taxable years beginning on or after Jan. 1, 2011
Sunset Date: Expires Jan. 1, 2016

Estimate (in millions): Unavailable

Data Source: Department of Revenue "Economic Incentive Reports"

Note: No credits have been taken through tax year 2012.

5. **Other R&D Credit**
Citation: G.S. 105-129.55(a)(3)
Description: A taxpayer that has qualified North Carolina research expenses not covered under another subdivision of this section is eligible for 1.25% credit on expenses up to $50 million; 2.25% of expenses between $50 million and $200 million; and 3.25% of expenses over $200 million. The amount of credit taken in any tax year cannot exceed 50% of the taxpayer's tax liability after other credits taken. Unused credits can be carried forward 15 years.
Enacting Legislation: S.L. 2004-124 - effective for business activities occurring on or after May 1, 2005
Sunset Date: Expires Jan. 1, 2016

Estimate (in millions): FY15-16........$44.0 FY16-17 .... $24.8

Data Source: Department of Revenue "Economic Incentive Reports"

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Notes: Above are two examples of source data for tax expenditures, the top from Virginia, and the bottom from North Carolina. This is just a snapshot of the tax expenditure report from both states.

Figure A.2: Example of Budget Documents

VIRGINIA GENERAL ASSEMBLY / LIVE HELP / LIS HELP CENTER / LIS HOME

LIS

STATE BUDGET

Budget Bill ▾ Search

2015 Session ▾

• Budget Bill

2014 - 2016 Biennium
HB1400
› Introduced
› Enrolled
› Chapter 665
SB800
› Introduced

Budget Amendments

Committee Reports

2015 Session

Budget Bill - HB1400 (Chapter 665)

Bill Order » Office of Commerce and Trade » Item 101

← Item → Print PDF Email Item Lookup ex. 43, C-1, 3-3.01

Economic Development Incentive Payments

Item 101	First Year - FY2015	Second Year - FY2016
Economic Development Services (53400)	**~~$52,160,436~~** ***$62,076,436***	**~~$67,863,444~~** ***$79,363,444***
Financial Assistance for Economic Development (53410)	~~$52,160,436~~ *$62,076,436*	~~$67,863,444~~ *$79,363,444*
Fund Sources:		
General	~~$51,910,436~~ *$61,826,436*	~~$67,613,444~~ *$79,113,444*
Dedicated Special Revenue	$250,000	$250,000

Authority: Discretionary Inclusion.

A.1. Out of the amounts in this Item, ~~$10,000,000~~ *$19,916,000* the first year and ~~$10,000,000~~ *$20,750,000* the second year from the general fund shall be deposited to the ~~Governor's~~ *Commonwealth's* Development Opportunity Fund, as established in § 2.2-115, Code of Virginia. Such funds shall be used at the discretion of the Governor, subject to prior consultation with the Chairmen of the House Appropriations and Senate Finance Committees, to attract economic development prospects to locate or expand in Virginia. If the Governor, pursuant to the provisions of § 2.2-115, E.1., Code of Virginia, determines that a project is of regional or statewide interest and elects to waive the requirement for a local matching contribution, such action shall be included in the report on expenditures from the ~~Governor's~~ *Commonwealth's* Development Opportunity Fund required by § 2.2-115, F., Code

Summary by Purpose

24609 Commerce - Special Funds GF

CODE DESCRIPTION	2011-2012 ACTUAL	2012-2013 CERTIFIED	2012-2013 AUTHORIZED	2013-2014 INCR/DECR	2013-2014 TOTAL	2014-2015 INCR/DECR	2014-2015 TOTAL
REQUIREMENTS							
2535 NC Green Business Fund	104,040	0	0	0	0	0	0
2536 GREEN BUS ENERGY SUB GNT	7,522,630	208,725	0	0	0	0	0
2537 ENERGY RESEARCH GRANTS	15,625	0	0	0	0	0	0
2560 ONE NORTH CAROLINA FUND	104,484,675	49,685,986	54,000,000	-45,000,000	9,000,000	-45,000,000	9,000,000
2562 ONE NC SMALL BUSINESS	529,013	0	0	0	0	0	0
2564 JDIG FEES	405,646	190,489	448,020	0	448,020	0	448,020
2565 JDIG SPECIAL REVENUE	19,951,815	19,000,000	15,000,000	0	15,000,000	0	15,000,000
2566 INDUSTRIAL DEVELOPMENT	790,000	1,141,800	1,141,800	0	1,141,800	0	1,141,800
2567 INDUSTRIAL DEV UTIL ACNT	3,451,510	3,023,074	3,750,000	0	3,750,000	0	3,750,000
2584 ECONOMIC DEVELOPMENT RES	0	811,493	49,688	0	49,688	0	49,688
2586 JOB MAINT & CAP DEV FND	5,745,079	0	0	0	0	0	0
TOTAL REQUIREMENTS	143,000,033	74,061,567	74,389,508	-45,000,000	29,389,508	-45,000,000	29,389,508
ESTIMATED RECEIPTS							
2536 GREEN BUS ENERGY SUB GNT	4,589,395	208,725	0	0	0	0	0
2560 ONE NORTH CAROLINA FUND	110,000,000	5,000,000	9,000,000	0	9,000,000	0	9,000,000
2562 ONE NC SMALL BUSINESS	12,621	0	0	0	0	0	0
2564 JDIG FEES	213,000	176,475	176,475	0	176,475	0	176,475
2565 JDIG SPECIAL REVENUE	20,169,879	19,000,000	15,000,000	0	15,000,000	0	15,000,000
2566 INDUSTRIAL DEVELOPMENT	40,000	821,693	821,693	0	821,693	0	821,693
2567 INDUSTRIAL DEV UTIL ACNT	4,694,826	3,023,074	3,750,000	0	3,750,000	0	3,750,000
2586 JOB MAINT & CAP DEV FND	6,000,000	0	0	0	0	0	0
TOTAL RECEIPTS	145,719,721	28,229,967	28,748,168	0	28,748,168	0	28,748,168
CHANGE IN FUND BALANCE	2,719,688	-45,831,600	-45,641,340	45,000,000	-641,340	45,000,000	-641,340

Notes: Above are two examples of source data for economic development program spending, the top from Virginia, and the bottom from North Carolina. This is just a snapshot of a relevant part of the budget document from both states.

Figure A.3: Discretionary Spending: North Carolina

J·D·I·G
JOB DEVELOPMENT INVESTMENT GRANT

Award Year	Company Name	Grant Term (Years)	Expected Jobs	Indirect and Induced Jobs	Total Jobs	Estimated NC GDP Impact (millions)	Estimated Net State Revenue Impact (millions)
2015	Novo Nordisk Pharmaceutical Industries, Inc. III	12	691	4,276	4,967	$7,361	$208.8
2015	Premier Research International LLC	12	260	683	943	$568	$9.5
2015	RBUS, Inc. II	12	500	701	1,201	$583	$12.9
2015	Royal Appliance Mfg. Co.	12	200	398	598	$613	$14.5
2015	**Total (Grant Term is average)**	**12**	**4,788**	**13,363**	**18,151**	**$15,995**	**$354.4**
2016	Aurobindo Pharma USA Inc.	12	275	1,231	1,506	$1,126	$15.8
2016	Avadim Technologies Inc.	12	551	1,359	1,910	$1,817	$43.2
2016	Citrix Systems, Inc. II	10	400	640	1,040	$659	$8.1
2016	Corning Optical Communications LLC (Cable)	12	205	345	550	$460	$8.7
2016	CSX Intermodal Terminals, Inc.	12	149	170	319	$2,485	$97.1
2016	Everest Textile USA, LLC	12	610	698	1,308	$733	$15.5
2016	GF Linamar LLC	12	350	349	699	$606	$8.4
2016	GKN Driveline Newton, LLC II	12	143	284	427	$307	$5.9
2016	GKN Driveline North America, Inc. III	12	159	316	475	$449	$10.7
2016	INC Research, LLC II	8	550	836	1,386	$750	$6.2
2016	JELD-WEN, Inc. II	12	206	313	519	$456	$7.2
2016	K-Flex USA L.L.C.	12	100	125	225	$231	$4.4
2016	LendingTree, LLC	12	314	1,061	1,375	$1,106	$22.7
2016	PrescientCo Inc.	12	205	258	463	$444	$9.6
2016	Relias Learning LLC	12	470	790	1,260	$1,583	$43.5
2016	**Total (Grant Term is average)**	**12**	**4,687**	**8,775**	**13,462**	**$13,212**	**$307.0**

Notes: This is an excerpt from North Carolina's 2013 Job Development Investment Grant Report. For each firm they receives a discretionary subsidy from the program, there is a description of the characteristics of the firm: the expected direct jobs, indirect jobs, total jobs, increase in state GDP, and increase in state revenue.

A.1 Runner-up State Examples

Figure A.4: Sources for Identification of the Runner-up State

December, 2002

Incentives Deal of the Month

from *Site Selection*'s exclusive New Plant database

Oregon Incentives, Idle Plant Are 'Fab' for Microchip's Expansion Plans

by **JACK LYNE**, *Site Selection* Executive Editor of Interactive Publishing and **ADAM BRUNS**, *Site Selection* Managing Editor

GRESHAM, Ore. – Spurred by US$17.3 million in state incentives, Microchip Technology (www.microchip.com) has hired the first 60 of what may be as many as 688 employees at its newly acquired facility in Gresham, Ore. - a turnaround that one local official calls "a miracle."

At full capacity, the 826,500-sq.-ft. (76,782-sq.-m.) facility that Microchip purchased (pictured) will double the company's chip-production capacity.

Gresham had needed something like an economic miracle since late last year. That was when Fujitsu announced that is was shutting down its local flash-memory plant, laying off 670 employees. The 826,500-sq.-ft. (76,782-sq.-m.) facility - Fujitsu's first U.S. fab - had been sitting idle since early this year, edging dangerously close to white-elephant status. Razing had become a distinct possibility in the facility's future.

Enter Microchip Technology. The company, which makes microcontrollers embedded a wide array of commercial, industrial and consumer products, was no stranger to the Pacific Northwest. In 2000, Microchip bought an existing Matsushita fab in Puyallup, Wash., 155 miles (249 kilometers) north of Gresham. The Puyallup fab, which is also currently idle, was the clear frontrunner in Microchip's U.S. expansion plans - and even after the company first got wind of the Fujitsu plant's availability.

(a) *Site Selection* Magazine

Electrolux Home Products, Inc. ("EHPI")

In addition to North Carolina, EHPI management considered two other potential locations: South Carolina and Tennessee. South Carolina offered several desirable locations in York and Lancaster Counties. South Carolina submitted a formal proposal that included significant up-front cash incentives and cash grants valued at approximately $54 million. EHPI recently established a large manufacturing facility in Memphis, Tennessee. That facility was located there after extensive analysis of the incentives offered in Tennessee, Alabama, and North Carolina. Tennessee was chosen in large part due to its superb incentive package.

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(b) State of North Carolina Subsidy Report

- Nexteer Automotive (Steering Solutions Services Corporation) - The former steering division of Delphi Corporation, which operates in **Saginaw** under the Nexteer brand name, is the only global Tier One automotive supplier focused on advanced steering and driveline systems technology. The company plans to invest $413 million to actively pursue diverse new business opportunities. The project will retain 8,711 total jobs, including 2,400 directly by the company. The MEDC estimates the increased economic activity created by the project will retain an additional 6,311 indirect jobs. Based on the MEDC's recommendation, the MEGA board today approved a state tax credit valued at $70.7 million over 10 years to encourage the company to expand in Michigan over competing sites in Europe and China. Buena Vista Charter Township is considering an abatement in support of the project. http://www.nexteer.com/

(c) State of Michigan Press Release

Notes: This figure contains three examples of sources that I use to find information on the runner-up state in the subsidy competition. The source can be an article from a magazine or newspaper (a), state reports on discretionary subsidies (b), or state/company press releases (c).

A.2 Data Snapshot

Figure A.5: Subsidy Source Data

Subsidy Tracker Individual Entry

Company: Toyo Tire

Parent Company: Toyo Tire & Rubber

Subsidy Source: multiple

Location: Georgia

City: Cartersville

County: Bartow

Project Description:
Tire plant

Year: 2004

Major Industry of Parent: automotive parts

Specific Industry of Parent: automotive parts-tires

Subsidy Value: $71,000,000

Program Name: multiple

Awarding Agency: multiple

Type of Subsidy: MEGADEAL ?

Number of Jobs or Training Slots: 900

Wage Data: $15

Wage Data Type: estimated average hourly wage

Capital Investment: $392,000,000

Source of Data:

The outlines of the project and subsidy details were taken from: "Bartow County makes formal proposal for $392 million tire plant," The Associated Press State & Local Wire, June 4, 2004. The total subsidy amount and wage data were taken from: Christopher Quinn, "The cost of new jobs; Incentives for tire plant spark debate in Bartow," The Atlanta Journal-Constitution, August 23, 2004.

Notes:

The state of Georgia and Bartow County approved a subsidy deal for Toyo Tire to locate a tire plant in the county. Toyo Tire received $8 million in infrastructure and land, $1,750 in state tax credits for each job created (potentially 900 jobs total), tax abatements for five years (undisclosed amount), exemption from state and local sales taxes for equipment purchases, and possibly other incentives. The deal also had three phases of investment from the company: (1) $146 million and 350 workers, (2) $127 million and 300 workers, and (3) $119 million and 250 jobs. Overlap with main Subsidy Tracker data: none.

Source Notes: If an online information source is not working, check the Tracker inventory page for an updated link.

(a) Toyo Tire

Subsidy Tracker Individual Entry

Company: Microchip

Parent Company:

Subsidy Source: state

Location: Oregon

City: Gresham

Project Description:
Semiconductor fabrication

Year: 2002

Subsidy Value: $13,100,000

Program Name: Strategic Investment Program

Awarding Agency: Business Oregon

Type of Subsidy: property tax abatement

Source of Data:
Direct from Business Oregon; not on web

Notes:
Year is year of approval; subsidy value is cumulative amount of abatement through 2010

(b) Microchip

Notes: These are two examples of the information available in the *Good Jobs First* Subsidy Tracker. Each entry is a subsidy deal. Both entries include the company name, location, project description, year, size of the subsidy, and source of the subsidy funds.

A.3 Data Integrity

I do two checks to ensure the data integrity of the sample of subsidy deals from *Good Jobs First* (GJF) subsidy data[77]: (1) Compare subsidies for new establishments against establishment entry in Business Dynamics Statistics, (2) Compare subsidies for the state of Virginia with an administrative list from a contact at Virginia's Joint Legislative Audit & Review Commission (JLARC).

Table A.1 displays the results comparing establishment entry from the Census with the subsidy data. Note that 52 new manufacturing establishments with over 1000 employees entered the U.S. between 2008 and 2014, and I observe 52 manufacturing firms promising over 1000 jobs receiving discretionary subsidies in the GJF data over the same period. The numbers do not always line up at the annual level, as the GJF data sometimes uses the year the deal was made (before the establishment physically locates in the state), and other times the year the subsidy began to be disbursed (after the establishment locates). As the establishments get smaller they are less likely to receive a discretionary subsidy (50% of establishments creating 500-999 direct jobs are presumed to receive discretionary subsidies, and 6% of establishments creating 250-499 jobs), or the subsidy they do receive is too small to be picked up in my sample selection process. These data checks suggest that the GJF data has a fairly comprehensive list of large subsidies given for establishment location.

Table A.1: Manufacturing Entry vs. Manufacturing Subsidy Deals

	Establishment Entry			**Subsidy Data**		
Year	250-499	500-999	1000+	<500	500-999	1000+
2008	147	34	12	9	6	9
2009	123	27	7	3	11	11
2010	106	9	8	6	10	8
2011	94	23	4	3	12	5
2012	78	9	6	8	12	5
2013	89	12	7	14	7	6
2014	90	31	8	12	15	8
Total:	727	145	52	55	73	52

Notes: The left side of the table above lists the counts of manufacturing establishments entering U.S. states by year and size of establishment, according to the Census Business Dynamics Statistics. The right side of the table lists the counts of manufacturing establishments that received discretionary subsidies from states for entering or expanding, in my dataset of discretionary subsidy deals.

[77] Which I also supplement with the data from *Site Selection* magazine.

A.4 Extended Descriptive Statistics

Table A.2 shows how state-level economic and political characteristics correlate with per capita business incentive spending, within a state. Decreases in the employment to population ratio are correlated with large increases in per capita incentive spending. A state with 1% lower employment ratio spends 8.6% more on business incentives per capita. The same is true in differences; a state that experience a 1% decrease in the employment ratio in the previous year will increase per capita incentive spending by about $4 (or 7%). This is further descriptive evidence than heterogeneity in local labor markets may drive differences in subsidy spending, as states which struggle to create jobs have a higher valuation for the marginal job (Bartik, 1991; Bilal, 2019). The table also shows that when governors are term-limited they are likely to decrease per capita incentive spending.[78]

Figure A.6 presents the data I have available on the number of competitors in each subsidy competition. The goal in collected data on "number of bidders," is to get a sense of the number of sites a firm was considering in the subsidy competition. A bidder need not be a location that offered a subsidy deal, and when I simulate the locations that will be in this set of "bidders" I do not restrict valuations or subsidies to be positive.

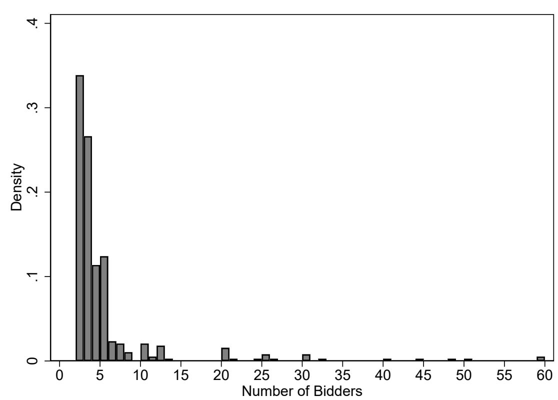
[78]Past literature in public economics has found evidence of political motivations for policy changes (Besley and Case, 1995; Poterba, 1994). It is also possible that these subsidies are driven by corruption—governors can use discretionary incentives to funnel money to their friends and political supporters. Industries that have greater political influence in a state, such as oil and gas in Louisiana and Texas, may use their political capital to ensure more financial support from the government. I will not be able to speak to these motivations in this paper, but it is a rich area for further work.

Table A.2: State Characteristics and Total Incentive Spending

	Per Capita Incentives ($)				Δ Per Capita Incentives ($)			
GDP per capita ($1000)	0.75			1.95				
	(0.42)			(0.48)				
% Population Employed		-2.62		-4.74				
		(0.97)		(1.11)				
Corporate tax rate (%)			2.18	2.48				
			(1.26)	(1.24)				
Δ_{t-1} GDP per capita					-0.67			-0.40
					(0.78)			(0.78)
Δ_{t-1} % Pop. Employed						-3.96		-3.83
						(1.49)		(1.50)
Term-limited Governor							-7.87	-7.87
							(3.30)	(3.27)
Observations	384	384	384	384	336	336	336	336
R-squared	0.85	0.86	0.85	0.86	0.07	0.09	0.08	0.11
Dep. Var. Mean	54.76	54.76	54.76	54.76	0.09	0.09	0.09	0.09
Ind. Var. Mean	52.80	36.41	6.51		-0.02	-0.31	0.30	

Notes: This table presents the results of a linear regression of state characteristics on state per capita business incentive spending. The panel on the left regresses state characteristics on per capita incentives, and the means of each variable are recorded below the R^2. The panel on the right regresses changes in per capita incentives between $t-1$ and t on changes in state characteristics between $t-2$ and $t-1$, as well as whether the governor can run for re-election. Observations are at the state-year level, state and year FE are included in each specification, and the sample is 2007-2014. Standard errors reported in parentheses. Sources include the U.S. Bureau of Economic Analysis (1967-2017) (population, GDP), the Census Bureau County Business Patterns (1997-2017) (employment), National Institute on Money in Politics (2000-2018) (term limits), and the author (state business incentive spending). States' total business incentive spending is not limited to discretionary subsidies. Business incentive spending includes all tax credits and economic development programs, such as job training programs, that the state has available to new and expanding businesses. Descriptive statistics for the state level incentive spending data are presented in Slattery and Zidar (2020).

Figure A.6: Number of Reported Bidders



Notes: This is the distribution of number of locations competing in the subsidy competitions in the data. I have information on the number of bidders for 95% subsidy deals. If the only information on the number of bidders is the identity of the runner-up, and there is no suggestion that there were other sites in contention, the number of competitors is assumed to be 2. In many cases the number of competitors is reported to be "at least *N*", and I take the number of bidders in those cases to be *N*. Therefore, this might be a lower bound. I assign the average number of bidders (5) to any observations where the number of bidders is reported to be "multiple sites" or "numerous states," but an actual number is not specified.

B Evidence for Assumption 1

Figure B.1 presents anecdotal evidence that states are aware of their competitors' subsidy offers. This is an excerpt from North Carolina's discretionary subsidy report (see Figure A.4(b) for another example from the same source). Therefore, the more demanding assumption is that states know the firm's profit in each state. Firms may not want to be truthful about where they have the highest profit, in order to extract a larger subsidy from the state.

Figure B.1: Evidence that states know competitors' subsidy offers

General Electric Company ("GE")

GE consists of eight primary business divisions: Oil & Gas, Energy Management, Power & Water, Healthcare, Transportation, Capital, Home & Business Solutions and Aviation. GE Aviation is a leading provider of commercial and military jet engines and components, as well as avionics, electric power, and mechanical systems for aircraft with an extensive global service network to support these products.

This project brings new manufacturing to North Carolina, including a facility for the production of advanced ceramic matrix composite (CMC) materials for aircraft and gas turbine engines. CMC components are lighter weight than existing materials used in engine production and allow for higher temperatures, increasing engine efficiency.

Nine states including North Carolina were considered for the project. South Carolina's incentive package was valued at $14.8 million while Virginia's totaled $11 million.

Calendar Year 2013 Legislative Report *17*

Additionally, South Carolina had several local incentive packages worth over $30 million over a 10-year period.

Notes: This is an excerpt from North Carolina's 2013 Job Development Investment Grant Report. For each firm they receives a discretionary subsidy from the program, there is a description of the firm and the competition. As detailed above, North Carolina is aware of the value of the incentive offers in runner-up states.

C Simulation Exercise: Model Predictions

In Figures C.1 though C.4 I present the results of model simulations. In these exercises I draw the two primitives of interest, (v, π), from the joint normal distribution. As a baseline$(v, \pi) \sim N(\mu, \Sigma)$, where $\mu = \left[\begin{smallmatrix} 5 \\ 5 \end{smallmatrix}\right]$ and $\Sigma = \left[\begin{smallmatrix} 1 & 0 \\ 0 & 1 \end{smallmatrix}\right]$. Given 1000 draws of v and π, I simulate the results of the subsidy competition game: the winning bidder, the total welfare gain, and the split of the welfare gain between the firm and state. I do this for different numbers of bidders, ranging from $N = 2$ to $N = 10$. The red dashed line in each figure represents this baseline result.

I repeat this exercise while changing Σ. Figure C.1 shows how the share of simulated deals with a positive welfare gain (e.g. the share of cases where allowing competition induced the firm to choose a higher welfare location) changes with the covariance of v and π (left panel) and the variance of v (right panel). The left panel in Figure C.1 shows that as the covariance between v and π grows the highest profit place is more likely to be the highest welfare place, decreasing the share of deals that induce firms to choose a different location. The right panel in Figure C.1 shows that the share of deals with a strictly positive welfare gain is increasing in the variance of v. An increase in the variance of v increases the variance in welfare, mechanically decreasing the correlation between w and π.

Conditional on changing location, the change in welfare echoes the same forces. This is shown in Figure C.2. The change in total welfare grows in the difference between the state valuation in the highest welfare location, v_1, and the state valuation in the highest profit location, v^0. Therefore, the percent change in welfare increases more dramatically with the variance of v, as the difference between v_1 and v^0 increases. The percent change in welfare, conditional on a strictly positive welfare gain, is not dependent on the number of bidders.

Figures C.3 and C.4 concern the split of the welfare gain between firms and states. Figure C.3 shows the change in firm payoffs and total welfare due to subsidy competition, for two different assumptions on bidders ($n = 2$ and $n = 10$). Figure C.4 is the firm's share of welfare gain. In almost all cases in this simulation the firm captures more than 100% of the welfare gain. The firm share is increasing in the covariance of v and π, and decreasing in the variance of v. As in Figure C.2, the share of the welfare gain that goes to the firm is not dependent on the number of bidders.

Figure C.1: Share of Deals with Strictly Positive Welfare Gain

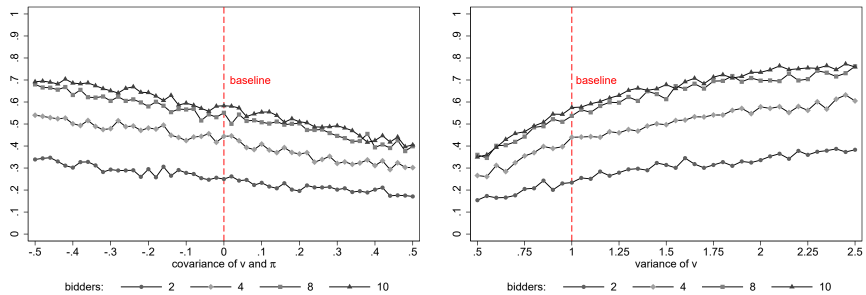


Figure C.2: Conditional on Changing Location, Percent Change in Welfare

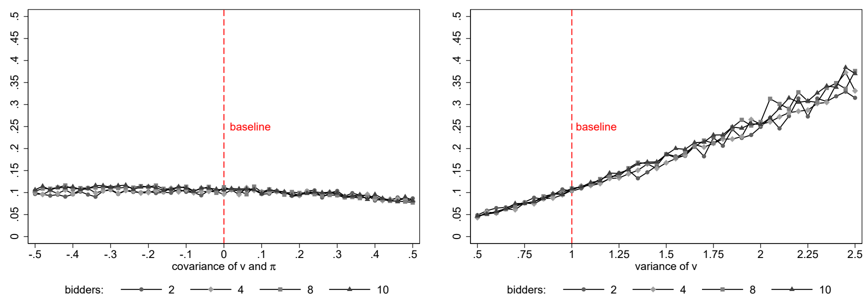


Figure C.3: Conditional on Changing Location, Change in Firm Payoffs and Welfare

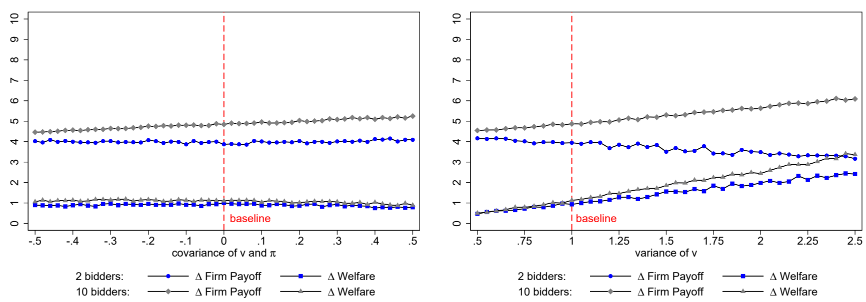
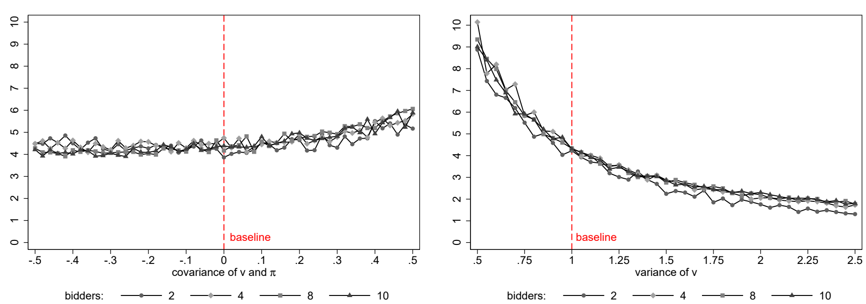


Figure C.4: Conditional on Changing Location, Firm Share of Welfare Gain



Notes: These 8 figures present the results of a simulated subsidy competition. As a baseline$(v,\pi) \sim N(\mu,\Sigma)$, where $\mu = \left[\begin{smallmatrix}5\\5\end{smallmatrix}\right]$ and $\Sigma = \left[\begin{smallmatrix}1 & 0\\0 & 1\end{smallmatrix}\right]$. On the left panel, the x-axis is the covariance of v and π. On the right panel, the x-axis is the variance of v.

D Location Characteristics

The variables that affect firm profits, x, include the state corporate income tax, the state personal income tax, the percent of local establishments in the industry of the firm, local housing prices, the size of the investment the firm plans, local industry wages, the number of jobs the firm promises, whether the state has a right-to-work law, the percent of the local population with a bachelor's degree, whether or not the locality has a research university, and whether or not the locality has a major airport. In the analysis the locality is the state-commuting zone pair, but estimation at the county and PUMA levels gives similar results. The variables that affect the state and local government's valuation of the firm also include the tax rates, jobs promised, investment planned, and local wages. Furthermore, valuations are a function of the local unemployment rate, per capita income, whether the area has experienced a decline in manufacturing employment, the industry multiplier of the firm, and whether or not the governor is term limited.

Data on promised jobs, investment, subsidy size, and industry of the firm are compiled by the author. The median wage and number or establishments in the industry is from the Census Bureau County Business Patterns (1997-2017), and the jobs multiplier is from the Economic Policy Institute (2019). Sources for state and local characteristics include the CSG Book of the States (1950-2018) (tax rates), National Institute on Money in Politics (2000-2018) (term limits), U.S. Bureau of Economic Analysis (1967-2017) (per capita income), National Conference of State Legislatures (2019) (right-to-work), Bureau of Labor Statistics (1990-2017) (unemployment), Ruggles, Flood, Goeken, Grover, Meyer, Pacas and Sobek (2019) (college graduates, jobless rate, density), Zillow (1996-2020) (housing prices), the National Science Foundation (2000-2017) (research universities), Bureau of Transportation Statistics (2019) (road conditions), and the Federal Aviation Administration (2019) (airports).

Table D.1 presents these statistics for the winning commuting zones, the runner-up commuting zones, and the entire United States. Winning locations have slightly higher state tax rates than the runner-ups, and are more likely to be right-to-work than the runner-up or average state. Winning and runner-up locations are also wealthier, more expensive, and dense, than the average commuting zone.[79] The industry-CZ specific variable highlight a striking difference between winners, runner-

[79] This is important from a policy perspective. In Slattery and Zidar (2020) we document that within winning locations poorer places pay more per job when they give a discretionary subsidy, but the poorest places are never the winner in the subsidy competition. The equity gains from using subsidies as a place based policy may be limited if the most distressed

Table D.1: Winning and Runner-up Places

	Winners			Runner-ups			All U.S.		
	Mean	Med.	SD	Mean	Med.	SD	Mean	Med.	SD
State-level:									
Corporate Tax (%)	6.39	6.90	2.58	5.96	6.50	2.88	5.91	6.50	3.06
Income Tax (%)	5.52	6.00	2.82	5.14	5.90	3.23	4.91	5.64	3.01
Right-to-Work	0.59	1.00	0.49	0.57	1.00	0.50	0.58	1.00	0.49
Term-limited Gov.	0.32	0.00	0.47	0.30	0.00	0.46	0.31	0.00	0.46
State-CZ-level:									
ln(Per Cap Income, $1000)	3.69	3.67	0.23	3.70	3.69	0.23	3.54	3.52	0.24
Housing Prices ($1000)	186.99	157.34	98.14	204.01	163.36	115.78	135.01	115.87	85.43
Density (1,000 Persons/Mile^2)	1.29	0.69	2.93	1.95	0.69	5.06	0.24	0.06	1.14
Major Airport	1.81	0.00	3.83	2.72	0.00	4.76	0.26	0.00	1.45
% Bad Roads	18.39	12.10	12.04	17.53	12.10	10.45	15.10	10.69	8.90
Research University	0.25	0.00	0.50	0.32	0.00	0.55	0.04	0.00	0.20
Prop. Population with BA	0.21	0.21	0.06	0.21	0.21	0.06	0.16	0.15	0.05
Prop. Population Jobless	0.28	0.28	0.04	0.29	0.29	0.04	0.28	0.28	0.05
Unemployment Rate (%)	6.72	6.28	2.34	6.55	6.01	2.27	6.44	5.92	2.67
% Change Manuf Emp.	0.05	-0.02	0.52	0.02	-0.02	0.35	0.09	0.00	0.77
State-CZ × Industry-level:									
% Change Sector Emp.	0.05	-0.01	0.48	0.02	-0.00	0.34	0.07	0.00	0.70
Share Industry Establishments	0.41	0.13	0.68	0.39	0.11	0.63	0.22	0.03	0.46
Industry Wage ($1000)	68.02	62.12	39.82	72.24	63.34	44.65	54.95	52.31	22.66

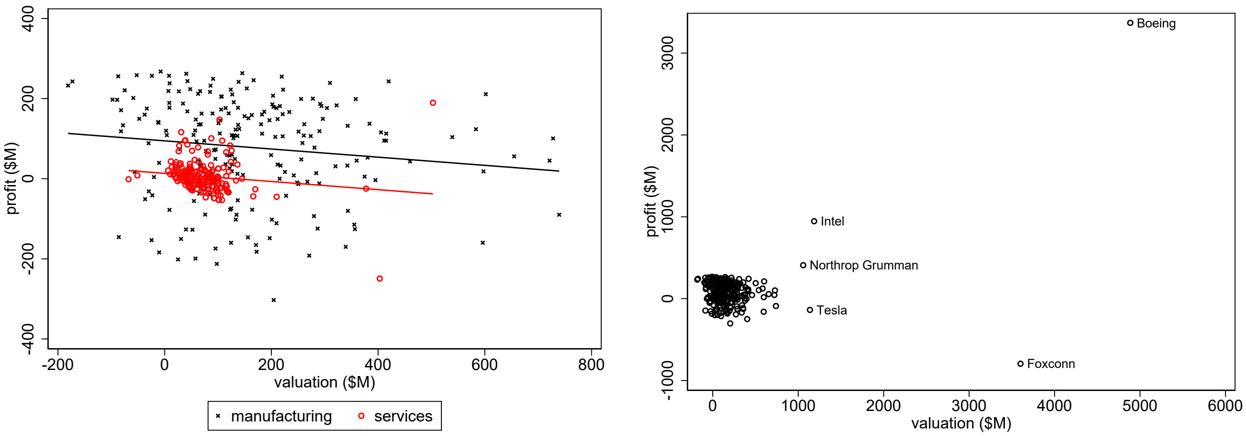
Notes: This table includes descriptive statistics for the places that win subsidy deals, are runner-ups in subsidy deals, and the entire United States. The observation level is at the commuting zone-industry-year, and the sample is 2002-2017. Industry wages and establishments is from County Business Patterns (1997-2017). Sources for state and local characteristics include the CSG Book of the States (1950-2018) (tax rates), National Institute on Money in Politics (2000-2018) (term limits), U.S. Bureau of Economic Analysis (1967-2017) (per capita income), National Conference of State Legislatures (2019) (right-to-work), Bureau of Labor Statistics (1990-2017) (unemployment), Zillow (1996-2020) (housing prices), Ruggles, Flood, Goeken, Grover, Meyer, Pacas and Sobek (2019) (college graduates, jobless rate, density), the National Science Foundation (2000-2017) (research universities), Bureau of Transportation Statistics (2019) (road conditions), and the Federal Aviation Administration (2019) (airports).

ups and the average CZ—winning places are more likely to have experience declines in employment in the industry of the firm than the runner-up or the average, but the industry of the firm has a much larger footprint (as measured by industry establishments) in the winner and the runner-up than the average. Also, industry wages are higher in both winning and runner-up locations.

places, still are not able to win firms, either because the subsidy offer does not overcome the fundamentals, or because they are budget constrained. I discuss this at greater length in Section 7.

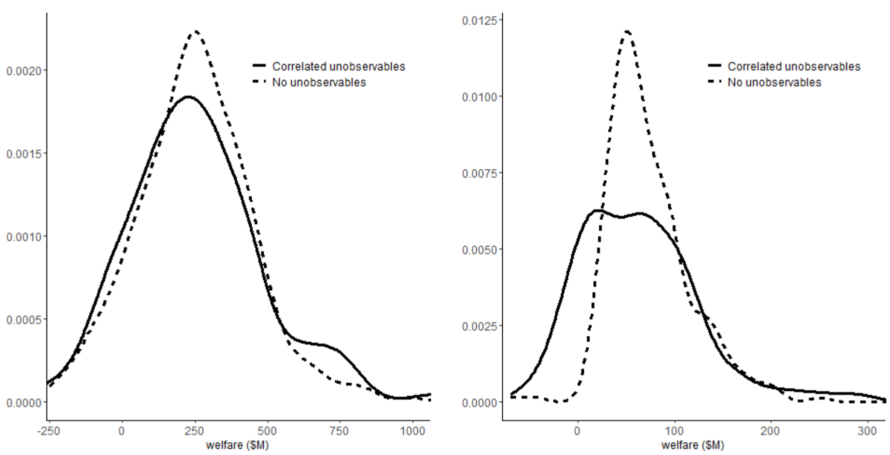
E Additional Estimation Figures and Tables

Figure E.1: Correlation between runner-up $\hat{\pi}$ and $\hat{v}$.



Notes: The figure shows a scatter plot of runner-up profits and valuations. The figure on the left excludes observations where the runner-up has a valuation over \$1.2 billion, and denotes services firms in red and manufacturing firms in black. This excludes Boeing, Foxconn, and Intel, which are included on the figure on the right. The correlation coefficient for services is -0.17 and the correlation coefficient for manufacturing is -0.11. Figure 7 shows the binned scatter plot of profits and valuations.

Figure E.2: Total Welfare in the Runner-Up Location



(a) Manufacturing (b) Services

Notes: The figure shows the density function of runner-up welfare. The empirical distributions are shown in Figure 8.

Table E.1: Model Fit: Winning Locations

	Manufacturing		Services	
State	Data (%)	Simulated (%)	Data (%)	Simulated (%)
AL	5.74	2.58	1.13	1.02
AR	3.83	4.15	0.00	0.56
AZ	2.39	1.73	0.00	1.93
CA	1.91	3.82	2.26	6.60
CO	0.00	0.19	0.00	0.58
CT	0.96	0.45	8.47	3.68
DE	1.44	0.56	1.69	0.79
FL	0.96	1.32	5.00	4.98
GA	3.35	4.71	1.69	3.07
IA	1.44	2.57	3.39	2.00
ID	0.96	1.27	0.00	0.32
IL	0.48	1.07	1.69	1.64
IN	2.39	2.07	1.69	1.15
KS	1.91	2.59	1.13	3.10
KY	3.83	3.22	3.39	2.64
LA	8.13	2.17	2.82	1.84
MA	0.96	0.96	1.13	1.30
MD	0.00	0.20	1.13	1.11
ME	0.00	0.08	0.00	0.00
MI	6.22	4.22	2.82	1.63
MN	0.00	1.53	0.56	0.66
MO	1.91	2.11	4.09	3.11
MS	5.26	3.31	0.00	1.08
MT	0.00	0.10	0.00	0.24
NC	11.48	8.93	18.07	10.25
ND	0.00	0.59	0.00	0.80
NE	0.48	1.50	0.00	1.01
NH	0.00	0.01	0.00	0.35
NJ	2.39	1.58	10.73	6.97
NM	0.48	0.32	0.00	0.23
NV	0.96	0.85	1.13	1.16
NY	2.39	2.37	3.39	6.18
OH	4.78	6.56	5.65	3.40
OK	0.48	1.00	0.56	1.60
OR	1.44	1.40	0.00	1.10
PA	0.48	1.17	0.56	2.34
RI	0.00	0.32	0.56	0.48
SC	5.74	6.56	0.00	2.31
SD	0.00	0.47	0.00	0.23
TN	3.35	3.47	1.13	1.77
TX	5.74	9.64	6.21	6.31
UT	0.48	0.67	4.52	2.92
VA	1.91	1.71	2.26	3.29
VT	0.00	0.21	0.00	0.40
WA	0.96	1.08	0.00	0.73
WI	1.44	1.50	0.56	0.57
WV	0.96	0.70	0.56	0.33
WY	0.00	0.41	0.00	0.24

Notes: This table shows the percentage of subsidy deals won by each state in the data and in the simulation. The percentages are shown separately for Manufacturing and Services firms. These simulated wins are the result of playing the subsidy game by simulating profits and valuations for each firm in the data, as described in Section 5.5. The simulated subsidy game is played 300 times. See Figure 10 for the model fit in terms of simulated and realized subsidy size.

Table E.2: State and Local Government Valuations: Alternative Specification

	Manufacturing		
Pctile	No Unobs.	Corr.	Indep.
25^{th}	-0.50	-19.68	27.33
50^{th}	108.40	240.22	253.50
75^{th}	275.38	555.98	537.31
90^{th}	455.33	843.33	813.49
Mean	164.18	286.03	305.17
	Services		
Pctile	No Unobs.	Corr.	Indep.
25^{th}	-3.48	-29.58	-8.48
50^{th}	22.86	53.59	62.53
75^{th}	77.91	148.94	146.64
90^{th}	187.09	239.35	238.01
Mean	79.34	75.7	91.96

Notes: This table shows the distribution of state and local government valuations, under an alternative specification of the firm profit function and runner-up valuations. The baseline specification, used in the main text, is specification 3, in both Tables 3 and 4 (corresponding to profits and valuations, respectively). The alternative specification, also in Tables 3 and 4, is specification 2. This alternative specification allows less industry and firm specific heterogeneity in the profit function, and the runner-up valuation is a linear function of jobs. Therefore, there is more left to the unobservable part of both profits and valuations.

For services, the residual is distributed with mean $\mu_\theta = 30.3$ and standard deviation $\sigma_\theta = 85.5$. I have $corr(\hat{\pi}_{2i}^{base}, \hat{v}_{2i}^{base}) = 0.41$ from the predicted runner-up profits and valuations, so I simulate the unobserved services productivity and valuation pair from $\binom{\xi}{\varepsilon} \sim N\left(\binom{\mu_\theta}{\mu_\theta}, \sigma_\theta^2 \begin{pmatrix} 1 & 0.41 \\ 0.41 & 1 \end{pmatrix}\right)$. For manufacturing, the residual is distributed with mean $\mu_\theta = 191.7$ and standard deviation $\sigma_\theta = 246.7$. I have $corr(\hat{\pi}_{2i}^{base}, \hat{v}_{2i}^{base}) = -0.18$ from the predicted runner-up profits and valuations, so I simulate the unobserved manufacturing productivity and valuation pair from $\binom{\xi}{\varepsilon} \sim N\left(\binom{\mu_\theta}{\mu_\theta}, \sigma_\theta^2 \begin{pmatrix} 1 & -0.18 \\ -0.18 & 1 \end{pmatrix}\right)$.

Given these alternative parameters for profits and valuations, I proceed with Steps 2-5 of the estimation process. The table above shows the results for the distributions of valuations, which I will use to repeat the counterfactual exercise (Table E.3). The distribution of valuations from the baseline specification are presented in Figure 9.

Table E.3: Welfare Analysis: Alternative Specification

A. Manufacturing ($44.1B in subsidies)

Baseline Specification: Table 3(a), spec. 3

	Jointly distributed π and v			Independent π and v		
$B	Ban	Comp.	Δ	Ban	Comp.	Δ
Valuation (v)	53.0	70.9		53.6	66.8	
Profits (π)	25.9	17.4	48% stay	25.3	17.4	50% stay
Total Welfare	78.9	88.3	11.8%	78.9	84.2	6.7%
State Payoff	53.0	26.8	-49.5%	53.6	22.7	-57.8%
Firms Payoff	25.9	61.5	137.4%	25.3	61.5	143.3%

Alternative Specification: Table 3(a), spec. 2

	Jointly distributed π and v			Independent π and v		
$B	Ban	Comp.	Δ	Ban	Comp.	Δ
Valuation (v)	51.8	75.2		53.5	71.3	
Profits (π)	33.3	23.1	42% stay	32.9	23.1	44% stay
Total Welfare	85.0	98.3	15.6%	86.3	94.4	9.3%
State Payoff	51.8	31.1	-39.9%	53.5	27.2	-49.1%
Firms Payoff	33.3	67.2	101.9%	32.9	67.2	104.4%

B. Services ($13.8B in subsidies)

Baseline Specification: Table 3(b), spec. 3

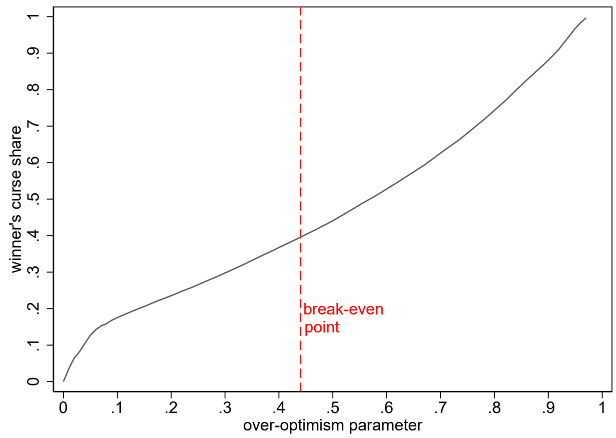
	Jointly distributed π and v			Independent π and v		
$B	Ban	Comp.	Δ	Ban	Comp.	Δ
Valuation (v)	12.1	16.5		12.6	16.3	
Profits (π)	6.6	3.5	54% stay	6.4	3.5	55% stay
Total Welfare	18.7	20.0	6.9%	19.0	19.8	3.8%
State Payoff	12.1	2.8	-77.1%	12.6	2.5	-79.8%
Firms Payoff	6.6	20.3	208.7%	6.4	20.2	214.2%

Alternative Specification: Table 3(b), spec. 2

	Jointly distributed π and v			Independent π and v		
$B	Ban	Comp.	Δ	Ban	Comp.	Δ
Valuation (v)	13.3	18.0		13.8	17.8	
Profits (π)	13.2	9.8	52% stay	13.0	9.8	53% stay
Total Welfare	26.5	27.8	4.9%	26.8	27.6	3.0%
State Payoff	13.3	4.3	-68.0%	13.8	4.0	-70.7%
Firms Payoff	13.2	23.5	78.8%	13.0	23.5	81.0%

Notes: This table shows the counterfactual results when I use an alternative specification of the firm profit function and runner-up valuations. The baseline specification, used in the main text, is specification 3, in both Tables 3 and 4 (corresponding to profits and valuations, respectively). The alternative specification, also in Tables 3 and 4, is specification 2. The distribution of the valuations for the alternative specification is shown in Table E.2. Given these distributions, I proceed with the counterfactual analysis, as described in Section 6. This table shows the result of the counterfactual analysis for both the baseline specification and the alternative specification. The counterfactual based off of the baseline specification is also shown in the main text (Table 5), but here I break the results out separately for manufacturing and services. For each specification the profits row also reports the percentage of firms that are predicted to stay in the same location (the subsidy competition winning location) in the counterfactual subsidy ban.

Figure E.3: Optimistic Bidders



Notes: I simulate the valuation for firm i (v_{is}) for winning locations s from $\hat{H}_V(v|\pi,z)$, but assume that all states are optimistic, and the true valuations is v^*, where $v_{is} = (1+oo)v^*_{is}$. The x-axis represents the parameter oo, or the level of "over-optimism." The y-axis shows the share of firms which have an observed subsidy (data) that is larger than the adjusted valuation, v^*. The dashed red line just above an over-optimism level is 40% denotes the "break-even point," where the additional value created by subsidy competition is no greater than the size of the subsidies.

Table E.4: State and Local Government Valuations: No Re-Election Effect

	Manufacturing	
Pctile	Baseline	All term-limited
25^{th}	-215.5	-247.6
50^{th}	76.6	47.5
75^{th}	412.4	386.7
90^{th}	756.5	747.5
Mean	125.3	113.4

Notes: This table shows the distribution of state and local government valuations, under the assumption that each state in the data has a term-limited governor. I predict valuations in the runner-up state by allowing each runner-up to be term-limited, and use these new valuations to calculate runner-up welfare. Then I repeat Steps 4 and 5 of the estimation procedure to recover the distribution of valuations. Table 4 shows that there is a significant effect of term-limits on the runner-up valuation for manufacturing firms; governors who are able to run for re-election are willing to pay over $40M more than their term-limited counterparts. There is not a similar finding in the valuations for services firms. Therefore, I only perform this exercise for the Manufacturing sub-sample, and I allow for correlated unobservables, so the relevant comparison is the baseline specification in the main text. The baseline results, from Figure 9(c), are shown in the first column. This table shows that valuations are smaller when the re-election effect is eliminated, as expected.